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*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

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RETROSPECT AND PROSPECT

IN beginning with the present Number what is practically a New Series of NATURE, the journal has reached a definite stage of its career, one at which it will perhaps not be considered out of place that we should make a reference both to its past and future.

That NATURE has succeeded in attaining the object for which it was started will, we think, be admitted by men of science both at home and abroad; and it is because NATURE has become more and more widely recognised as the organ of science all the world over, that at last we are compelled to enlarge it in order to find space for the stream of communications that week after week come pouring in upon us from all parts. If we have, either directly or indirectly, contributed to this spread of a taste for scientific knowledge, this is due to the untiring assistance and sympathy which the many students and friends of science in this and other countries have afforded us, and which aid we are anxious to take this opportunity of acknowledging. In the future, as in the past, we are sure this stream will continue to flow, so that the editor's function will, as heretofore, be a modest one.

Beyond this we need not dwell on the past and future of the journal. The work accomplished in the past nine years, and the direction in which it has progressed, is a much more important matter. Both writers and readers have, as it were, arrived at a stage of their journey. From it the countries which they have explored are still plainly visible, while those in front of them, never before trodden, even if they show fair promise of being similar to those already traversed, are shrouded in mystery, and may in truth turn out to be very different from what they seem.

We may take advantage, then, of this halt to glance at the nine years' crop of knowledge which NATURE has recorded; to consider the scientific progress accomplished in that period, and to seek for the indications afforded as to the lines along which activity may be expected in the future.

We certainly do live in deeply interesting times. Since the first number of this journal appeared there has undoubtedly sprung up a much greater general interest in science than was formerly to be found, and questions concerning scientific discovery, research and teaching, have now a much more direct interest to the public than they formerly possessed. No better test of this can be required than the continually growing space given to such matters by the daily press, and the more intelligent discussion of such questions as the endowment of research, and the importance of science at our universities and in our schools which is everywhere noticeable.

The matters to which we have just referred are, indeed, those in which a distinct progress has been made—a progress which we firmly believe is only a small foretaste of that which is to follow.

We have, ever since the journal was started, maintained, through evil report and good report, the crying necessity to the country of a greater endowment and a wider diffusion of pure science, because the one provides us with raw material, the other distributes it, so that throughout the length and breadth of the land, new manufactures in the shape of new applications of science may arise. There are many signs which indicate that the necessity of this, which is obvious at the present time only to the comparatively few, will be universally insisted upon. If it is not, future historians may have to show how different might have been our condition if our mental resources, which are doubtless as rich as our material ones, had been utilised in the same way; if education had done for mind, what, for instance, coal has been compelled to do for iron.

The Government has not been slow to recognise this growing interest in scientific matters. In the period to which we refer a commission, of which the Duke of Devonshire was chairman, and of which the two secretaries of the Royal Society were among the members, has gone over, and reported at length on, the whole field of scientific instruction and the advancement of science in the three kingdoms.

The only direct response made up to the present time by the Government to the recommendations of the Duke of Devonshire's Commission, has been the

endowment of scientific workers. The sum of 4,000*l.* placed at the disposal of a committee of the Royal Society for this purpose, was doubtless a large sum to begin with, and the committee has made a good beginning with it. The question was a delicate and a difficult one, and allowances must be made, but we doubt whether the intention of the Government will be fulfilled by increasing the stipends of professors who are already hard worked at institutions, the managers of which will now have a most excellent excuse for underpaying them; or by cutting down the personal grants to investigators to provide small sums for apparatus, which the fund was not primarily intended to meet.

Another recommendation of that Commission, namely, the formation of a museum of physical apparatus, complementary to the new museum of Natural History now being erected in South Kensington, has been more than half carried out. A loan Collection of Scientific Apparatus was formed as an experiment, and all, or almost all, have recognised the importance of a permanent museum of this nature.

The Duke of Devonshire's commission has given rise to three others, which have reported on the Universities of England and Scotland; and there is little doubt that out of these labours much good will come, though very likely it will be long in the coming. We say this because such ancient corporations as universities are the products of so many conditions that a mere determination to effect organic reforms, without minute examination, may do much more harm than good. The great point now is that the weak points of our university system are no longer within the ken merely of the few. There are hundreds of thousands of people now in the country who can contrast that getting of knowledge for knowledge sake, which is the glory of the German system, with that utterly demoralising cramming of things that pay in an examination, which is the disgrace of our own. Enough also is known of the activity of the laboratories and scientific workshops in foreign universities to create astonishment at the masterly inactivity in the matter of original work displayed in some of our own. To recognise such defects as these is half to rectify them.

There is now a prospect of science taking its place in our schools alongside of those other branches which until quite recently held exclusive sway in them; and it is probable that in the course of a few years, British schools will have reached the stage attained by German ones a quarter of a century ago.

The foundation of Colleges at Newcastle, Leeds, and Bristol, is among the signs of this increased activity in educational matters, while side by side with these new foundations, Owens College has now arrived at such a pitch of completeness and usefulness that its erection into a university cannot be long delayed. France, as well as ourselves, is now perceiving the advantages of the German system, and before long we may expect to find separate faculties abolished in that country, and the erection of many new universities. That at Lyons is almost already freed from the leading strings of Paris, and others will soon follow.

The Government has been largely influenced in another way—not only, indeed, our Government, but the whole civilised world. Never before in an equal period have so many expeditions been organised to distant parts of the world, to bring back rich fruits of pure knowledge of one kind or another. The voyage of the *Challenger* will for ever mark this century in the history of science, and our country must be congratulated as having so largely helped in the accumulation of the vast stores of new knowledge which that and other similar expeditions have gained for the use of all.

Animal forms new and strange, the secrets of the deepest depth of ocean, the coursing of the blood along the arteries of the world, the building up of a large portion of the planet itself; such are the topics which we shall hear much of during the next years, as volume after volume of these precious records makes its appearance.

It is not the fault of the men of science if the Polar expedition, which our Government, in friendly rivalry with America, Austria, Germany, Sweden, and other countries sent out, will not live so long in story as will the voyage of the *Challenger*. It is, after all, but a grim consolation that the elaborate instructions drawn up, and the valuable series of facts collected for the use of this expedition, will, beyond question, be found useful in a not distant future. The lesson we have learnt, however, goes to strengthen the view so definitely expressed by the German committee, that a mere dash to the Pole is precisely the thing that is *not* wanted. Careful scientific work, chiefly of the physical sort, carried on for a long period of time, and necessarily, therefore, by relays of observers, would in all probability furnish us with a large array of facts, which could at once be applied to the solution of many outstanding questions in various branches of terrestrial physics. The way of the winds alone, in these weirdest regions of the world, in itself presents a problem which may be of the highest importance.

We hope that the enormous sums which have been spent on the observations of the transit of Venus of 1874, will be amply justified by the result which will be obtained when all the observations of Europe and America have been discussed. It remains to be seen whether, when this has been accomplished, the transit of 1882 will have so great a charm for the astronomers as its precursor of 1874. In any case if so much money is to be spent on the determination of a numerical value which can be arrived at by physical means, it is but fair that the interesting physical phenomena which occur during a transit should not be neglected to so great an extent as they were on the former occasion. Those who control expeditions of this kind incur a grave responsibility if any avenue to knowledge is barred by them.

Our first number contained an account of an eclipse of the sun observed in 1869 in America. We commence our eighteenth volume while again in that country astronomers are vying with each other in perfecting their methods to observe the eclipse of next July. Since 1869 our Government has aided three eclipse expeditions: one to the Mediterranean in 1870, one to India in 1871, and one to Siam in 1875. A precedent has therefore been established by which active workers may profit in the coming time, for every solar eclipse and every piece of work at the uneclipsed sun raises questions—and will doubtless for ever go on raising them—which eclipses alone can settle.

Another mark of the recognition of science accorded by our Government has been the increase of the sum placed at the disposal of the meteorological Council, while at the same time a reorganisation of the administration of the Council has taken place. Perhaps the most startling event which has taken place during the last eight years touching the administration of scientific work in England, has been the nomination of the members of this Council by the Royal Society. Among these we do not find one of our distinguished meteorologists. We fear, therefore, that most of the meteorological work of the future will lie outside that body, a result which all must intensely regret, for there is enough loyalty to the Royal Society among British men of science to make them wish that everything it touches should succeed.

Never before have the larger questions of meteorology attracted so many minds: the connection of solar changes with terrestrial changes and everything which depends upon them, is now beginning to loom out of the mists of obscurity in a most gigantic shape. The subject is one of such intense interest to humanity, that here there must be no hasty work. The magnetician, the meteorologist, and the physicist, must march together with cautious tread, and when they do we shall doubtless in the next few years find the basis surer and surer, and the methods employed freer from that mutual criticism which makes outsiders think that meteorological butter depends more upon the churn than upon the milk. In any case we may congratulate ourselves that the next eight years will in all human probability give us a more unbroken chain of solar facts than that secured during the last similar period of time.

It is not only in the larger problems of physical meteorology that progress is being made. Nine years ago found us warning Deal from Valentia. We now, thanks to the public spirit of Mr. Bennett, of the *New York Herald*, warn Valentia from New York. The laws of the passage of storms over the Atlantic will soon, doubtless, be more within our grasp, and the next decade may enable us to watch the travels of a cyclone over a distance equal to half the circumference of the earth.

The Government explorations carried on by the *Challenger* and other expeditions, to which we have already referred, have not been the only ones which made the last decade a very remarkable one.

From the time of Marco Polo nothing more wonderful in the way of foreign travel than the stupendous feats accomplished by Cameron and Stanley in Central Africa have been placed on record. In the near future, and perhaps even in a more distant one, we are not likely to have to chronicle anything coming up to the level of the work accomplished by these men. Nor must we omit to mention Warburton, Giles, and Forrest, whose ride across the Australian desert was scarcely less remarkable. Exploration will doubtless still go on, but by the nature of the problem, it must be exploration of the less sensational sort, but by no means the less useful on that account.

Although these African and Australian adventures have been the greatest achievements of their kind which we have had to chronicle, there is scarcely any part of the world on which the explorer's activity has not recently left his mark. In fact, between Cameron, who makes a dash across a continent, and the much-to-be-pitied members of our own geological survey, who, according to a recent parliamentary paper, spend a year in mapping a region of twelve square miles, there is an unbroken series of workers, thanks to whose labours, *per mare per terras*, a complete inventory of our planetary riches is being got together.

Coming from exploration to the sciences of observation and experiment, when we have referred to the enormous increase in telescopic power on the one hand, and to the gradual consolidation and new grouping of facts on the other, we have, perhaps, referred to the most salient points. The increase of observing power since 1869, as is best evidenced by the discovery of two satellites of Mars, is simply stupendous; in that year we chronicled the erection of the Ferndene telescope; since then this telescope has not only been eclipsed actually, but in imagination dwarfed into such dimensions that it may serve as a finder to the telescope of the future. Henceforward the attempts of those who experiment on 10-feet mirrors will be the central point of interest.

The development which our knowledge of the motion of the intimate particles of matter has received during the last ten years from the work done on the kinetic theory of gases and in the exploration of spectroscopic phenomena, is greater than we have as yet any idea of. It will not be a surprising thing if, before very long, these two streams of work find their meeting-place as do the Rhône and the Saône at Lyons, when the clear formulæ of the kinetic theory, commingling with the already multitudinous but far from organised spectroscopic observations, shall form a noble river, the molecular science which in the coming time will embrace all others.

Another grouping, of which we have recorded the gradual consolidation, and which is destined to change the points of view from which many Aspects of Nature have been regarded, is that of physiography—a name which conveniently defines the region where the physicist, the chemist, the geologist, and the astronomer, find each a common interest. Such a grouping as this would, of course, be impossible in a planet where the chemistry of extraneous matter, or the origin of its own, presented problems beyond the range of investigation. But precisely because such points as these are continually receiving important developments here, this new grouping is destined to form a centre of an ever-widening interest —an interest from which all must gain, for so surely as all Nature is one, so must the work of each explorer, to be of its greatest value, form only a part of one combined attack.

The radiometer and the telephone are products of recent investigations in physics which of themselves are fit to mark an epoch, but first-rate work has been done besides, by which the continuity of the gaseous and liquid states of matter has been demonstrated, and the last gas reduced to a liquid form. The revival of the contact theory affords a new standpoint for electricians, while the ever-increasing analogies between light and magnetism which are being brought forward indicate that before long some vast generalisation may be expected in this direction. On all sides the interest attaching to physical problems is increasing, and it is well that this

is so, because the chemists among us are for the most part silent, and chemical theory is almost dead in England; indeed it would appear as if the centre of gravity of this science had gone bodily eastward, and Berlin and St. Petersburg now replace London and Paris so far at all events as organic chemistry is concerned.

But if the chemist has ceased to employ physical tools this is made up for by those large fields of physical work which are being more and more utilised by the physiologist. The introduction of physical methods into biological research is one which has already borne, and which will in the future bear, rich fruit, and all work of one kind in this direction will be as largely modified in the future by the introduction of physical methods as that of another will be rendered practically a new science by the generalisations of the immortal Darwin.

All experimental science will gain by this, for each branch of scientific work reacts upon all others, and while in the future a physiologist who simply knows how to use a microscope and a dissecting knife will be an impossibility, physics, on the other hand, will be sure to receive new methods of observation and new instruments from those who have been compelled to invent them for their new needs.

We have recorded the completion of, perhaps, the greatest work ever undertaken and carried to a conclusion by any one man. We allude to the planetary tables, the final touches of which were added by Leverrier only a few hours before a death which has left a void in science which it may take centuries to fill.

The physical side of geology has attracted much attention during the last nine years, and it has been our privilege to chronicle many investigations dealing with the interior structure and heat and the probable age of our planet. The facts collected by our surveyors with an activity which, especially in America, has been something beyond all parallel, thus find themselves supplemented by theoretical views, the fitting together of which, in the future, will be a work which will be second to none in interest.

Of practical applications of science made since 1869 the number is legion, and some are of high order. The advance in navigation, perhaps, is the most striking. We have not only in the way of new instruments the bathometer, a machine for taking flying soundings, and a perfect compass, but also the whole art of navigation promises to be revolutionised by the introduction of new methods. One thing which all friends of science should take to heart, has been abundantly established, the science most applied is the science of which the theory is bound to receive the greatest development. The telephone, duplex telegraphy, steam fog-signals, and the application of electricity to lighting, must also be mentioned.

From the prosecution of science itself we must turn to some of its surrounding conditions. We have had to watch, and have recorded with pleasure, the establishment of several new societies, and the strengthening of old ones since our first number was issued. Mathematicians have now a strong society; physical science is now represented in this way by the side of chemistry; while the latest born of these societies, though by no means the least active, is that devoted to mineralogy. We do not suppose the coming time will see a very large increase in the number of these bodies, but we think that it certainly will see a considerable influence of them all upon the Royal Society. It would be a loss universally deplored if the Royal Society were to abate one jot or tittle of its influence, but with active societies all round it representing each branch of inquiry and at once discussing each advance of knowledge in full meetings, it is difficult to understand that the Royal Society may not suffer if some better method than the one at present adopted of providing for the reading of the multitude of papers presented to it is not adopted.

From our own English societies we once more come to individuals, and here our task is a sad one. It is almost impossible to name a period of nine years during which death has played such havoc among men of science of all nationalities. Herschel, Graham, Wheatstone, Sedgwick, Lyell, and Murchison are no more; Leverrier, the great Leverrier, has gone with Regnault, Milne-Edwards, Claude Bernard, Becquerel, and many other Frenchmen of note. America has lost Agassiz; Germany, Liebig, Argelander, Erdmann, Mayer, and Heis; Russia, von Baer and Mädler; Italy, Secchi; while in all countries the thinning of the ranks of men of lesser note has been disastrous. We may surely hope that in our new series the sad task of bidding farewell to men who have done their work in science may fall less frequently upon us.

EDITOR

THE AMERICAN STORM WARNINGS

THE interest excited in Europe, and particularly in England and France, by the weather predictions cabled by the *New York Herald* to its London Office during the past year (commencing February 14, 1877) proves that these warning messages are regarded as important to the interests of commerce, navigation, and agriculture. The generally expressed opinion as to their accuracy is a favourable one, and is justified, I believe, by the fulfilment of a very large percentage. Such a result of the first year's work affords me unqualified satisfaction. It represents all the success I aimed to attain, and much more than I hoped to win.

I will state at the outset that the carrying out of the whole project of warning the European coasts of the approach of storms has depended on, and has been sustained by, the munificence and generous enterprise of Mr. James Gordon Bennett, the proprietor of the *New York Herald*, whose encouragement and support of every undertaking calculated to promote the advancement of science and discovery are well known and appreciated. The work accomplished so far is the result of some years' study of the phenomena of atmospheric movements. The deductions, therefrom, I have endeavoured to reduce to a practical application in these cabled weather-warnings of the *New York Herald*. In this, I believe, a useful step has been made in meteorological inquiry, which may lead to greater and more definite results.

Before February 19th, 1877, the day on which the first weather warning of the *New York Herald* (sent on the night of the 14th) was fulfilled, the question as to the possibility of establishing a reliable connection between

the meteorological phenomena of the American and European continents was unsettled. In stating this I do not ignore the efforts previously made with that object by many scientific men in Europe, like the late M. Leverrier, Director of the Paris Observatory. In many scientific circles the possibility had long ago grown to be regarded as a probability, and public as well as private efforts were being constantly made toward a thorough investigation of the laws of atmospheric movement and of storms. Indeed the failures, so called, that attended these researches were, in reality, successes of the highest importance to meteorological science, because they taught the investigators to eliminate all that was worthless in theory, and pay closer attention to the simpler and grander facts of nature which direct and patient observation made apparent. The chief difficulty in the way of success lay in the limited area of the physical field of investigation. Local phenomena have been treated as general, and the observations made in a comparatively small district have been used to found the theories applied to a hemisphere.

Except in few cases, recent works on meteorology are barren of original information. They are chiefly mad up of quotations from earlier works, and the experiences of isolated observers who, straining after the establishment of narrowly based theories, permit their enthusiasm to lead them to false conclusions. This accusation may, and probably will, be levelled against myself, but I assure the critics that I will submit to any adverse judgment on my work that is based on scientific truth and feel grateful for the enlightenment. Whatever may be the value, or otherwise, of the statements I make, they are based upon personal observations, and depend in no way on the generally accepted meteorological theories with regard to the origin and movement of storms. I aim at winning for my work all that may be due to its merit, while I am willing to bear all the censure for its defects.

The importance to the interests already referred to of a system of weather predictions, which can be published for the general information of the people, several days in advance of the events they announce, is one that cannot be disregarded. We find in America that many branches of trade are seriously affected by weather changes, and that timely warnings are calculated to insure against losses that would, in their absence, be sustained. The great grain-growing districts of the Western States have their respective centres to which the produce is brought for sale, storage, and shipment to the eastern sea-board. Sudden and severe storms not only injuriously affect the condition of the roads and other lines of transportation, and thus delay shipments, but also the produce itself; and the anxiety of the farmer for the safety of his crops is equalled by that of the merchant whose capital is invested in that special branch of trade. Hence, both producer and dealer, as well as the transportation agent, anxiously watch the western horizon, and eagerly receive every item of information bearing on the all-important condition of the weather. The same state of feeling must exist wherever trade flourishes and agriculture represents wealth. Whether the corn be stored in a Chicago elevator ready for shipment to Europe, is borne by the steamship across the Atlantic, or is stored at the centres of consumption in England and France, the conditions vary only in degree. The cotton-fields of the Southern States, the cotton ships on the ocean, and the staple stored in the warehouses of Liverpool or Manchester are under the same all-pervading influence of the weather.

To the seaman the timely storm warning is of paramount importance. Whether he threads his dangerous course among narrow channels along the coasts, or sails boldly into the broad ocean, the foreknowledge of an approaching storm causes him to adopt those precautions which insure his safety. The dreadful story of shipwreck which has been continued through the annual chapters of the past twenty-five years, will reach its hoped-for "*Finis*," when meteorological science effectually aids the nautical skill of the mariner in warding off the great dangers of the sea. Then the headlands of every coast will have their signal stations, and the sailor when taking his parting look at the land he is leaving, or getting his first of that he approaches, will see the warning signal that shall tell him of coming storms, and bid him prepare to meet them.

In many other respects the value of timely storm signals will be immense. Take, for instance, the case of an army on campaign. The general commanding mus regulate his movements as much by his facilities for transportation and supply as by strategic necessities. He must cross rivers and wade through marshes; climb and hold rugged mountain passes; and secure his communications by substantial bridges and practicable roads. His supplies must be largely drawn over difficult routes, and, perhaps, from districts liable to inundations and heavy snow or rain storms. If he relies on a co-operating fleet, the ships must be guarded against storms in exposed anchorages. In a word, the variations in the conditions of the weather must be recognised in all the operations of an army, otherwise great disasters may overtake it, notwithstanding the valour and endurance of the troops and the skill of the commander. I have watched with the greatest interest the progress of the recent campaign in Bulgaria, and have frequently announced in New York many days in advance the changes of weather that impeded the Russian progress, endangered the Danube bridges, and filled the Balkan passes with snow. Such calamities as befell Napoleon in 1812, and a portion of the allied forces in the Crimea in 1854-55, would have been avoided if a meteorological service existed at those times to give warning of the weather changes that produced them.

If a special military service of meteorologists, such as the United States enjoys in its Signal Service Corps, was organised in European armies, many of the difficulties incidental to warfare on that continent could be provided against. But as the foundation of such a system must rest on the accuracy of weather predictions by cable from America, the duties of an Army Signal Corps in Europe with relation to the weather would be simplified to a close observation of the western and southern coasts or frontiers, and the forwarding of information to the proper points. At the present time the European western coasts cannot receive by local observations what can be called timely storm-warnings in the strict sense of the term. The British Channel, the German Ocean, the Baltic, and

West Mediterranean, which represent the chief commercial areas of home navigation, are near the points where the first weather indications present themselves. It is not surprising, therefore, that notwithstanding the vigilance of coast-observers, and the prompt distribution of warnings from London and Paris, that many vessels are overtaken and fairly surprised by storms within sight of the British and French coasts. The *New York Herald* warnings have been forwarded to lessen this danger to navigation in European waters, as well as to give notice of bad weather in the Atlantic to vessels bound for our coasts.

I shall first deal with the field of observation from the West Pacific Ocean to the Ural Mountains.

I will limit my remarks on the general and local phenomena of storms, to which the *New York Herald* system of cable weather predictions relates, to the field of observation that extends from the western part of the Pacific Ocean in a great but irregular zone, eastward to the line of the Ural Mountains.

The irregularity in the width of this field which lies generally between the 10th and 70th parallels of northern latitude is caused by our want of information regarding the meteorology of the far northern sections of this continent and of the region in North Africa between the equatorial zone and the northern limit of the great desert of Sahara.

While the prevailing conditions in these regions may be correctly inferred from their relations to contiguous territories, it will be unsafe for the present to base any assumptions thereon, especially when such are not absolutely necessary for my purpose in this article. I will therefore refer only to the Pacific Ocean, between the 10th parallel and the Aleutian Islands, the North American continent between the same parallel, and the regions of Manitoba and north of the great lakes and Canada; the Atlantic between a line drawn from the intersection of the 40th meridian and the 10th parallel, to the African coast at Cape Blanco; and the line drawn from Cape Farewell, in Greenland, and the North Cape, in Norway; and Europe between the 30th and 70th parallels.

This immense area contains two great oceans familiar to navigators, and the two continents that represent in the majority of their peoples, the commercial enterprise, the power, and the intelligence of the world. It also represents a considerable portion of the earth's surface subjected to a diurnal and equal share of solar influence according to latitude. Whatever may be the real effect of the sun's heat and magnetism in producing atmospheric perturbations, the field selected is that which they must almost uniformly influence, and on which the extent of that influence is most likely to be accurately determined by scientific observation and study.

It will be observed that the oceanic and continental areas are each divided into two sub-areas by well-marked lines; the oceans by equatorial currents having a general direction from south-west to north-east, and the continents by distinct regions of mountain and plain. The distinction in the latter case is most marked on the North American continent, but is also very clearly defined in Europe. We have therefore eight sub-areas of the field of observation, each exercising its peculiar influence on the movement of the atmosphere over the whole field. The *Kuro Siwo* or Japan current of the Pacific Ocean, which corresponds so closely with the Gulf Stream in the Atlantic, moves north-eastward with a smaller resistance from the north polar waters than the Gulf Stream. The narrow Behring Strait, through which the Arctic current must pass southward is even narrower than Smith Sound, consequently the northern waters of the North Pacific maintain a higher general temperature than those of the North Atlantic, but owing to the spreading out of the *Kuro Siwo* over a greater area than the Gulf Stream covers in corresponding latitudes, the waters of the latter are relatively warmer and probably deeper between latitudes 30° and 60°. Hence a more uniform temperature overspreads that part of our field of observation represented by the North Pacific Ocean. It is reasonable to suppose that the compensatory flow of polar water toward the equator comes chiefly from the Antarctic regions in the Pacific Ocean and in nearly equal proportions from both poles in the Atlantic. The effect therefore must be, as I suggest, that the surface of the North Pacific has a very uniform temperature, making due allowance for latitude. The atmospheric conditions are consequently affected so far as to promote the development of large areas of low pressure without many important centres of very violent disturbance. I cannot say if the infrequency of storm centres, as we are accustomed to regard them, on the Pacific, suggested the name, but it cannot be considered an inappropriate one. Violent storms cross the northern parts of this ocean, but they come from the Asiatic continent, and are probably identical with those which had already passed over Northern Europe in their eastward courses. We have no satisfactory evidence that such storms again pass over Europe, but they undoubtedly traverse the circumpolar seas, carrying to those regions the great winds and snows that are experienced by whalers and explorers in the far north.

Over such an immense area of warm water surface as the Pacific presents the atmosphere absorbs an extraordinary evaporation, and in its general eastward movement brings the humid air to the western coast of the American continent, where, by condensation against the mountain chains that extend from Lower California to the Arctic Ocean, it becomes deposited in heavy rains. The liberation of latent heat consequent to this process causes a barometric fall near the coast line, and the development of storm centres which move inland over the Continent, and have been traced from Oregon to Armenia. Cyclones that are developed in the equatorial zone of the Pacific cross the ocean and are experienced on the American coast from latitude 20° to 55°, according to their point of origin, and high or low trajectories. The movements of these storms will be referred to under another head.

On the North American Continent the mountain sub-area extends eastward from the Pacific Coast to the line of the Rocky Mountains. It is represented by a great elevated plateau from four to eight thousand feet above the sea-level, and from three to six thousand feet above the general level of the sub-area of the plains which extends eastward from it to the Atlantic. The peculiar alignment of the axes of the mountain chains running

over this great plateau presents them as direct obstructions to the eastward movement of storms, and their influences on the latter are very marked. Indeed the most interesting study in American meteorology is that of the modifications produced by the great mountain plateau of the west, or the disturbances passing over it. The sub-area of the plains is that in which some of the most remarkable phenomena of storms are observed. The valleys of the Mississippi, Missouri, and Ohio, and the basins of the lakes and Gulf of Mexico are the theatres of tremendous storm movements, and are consequently the favourite areas for observation chosen by American meteorologists. Within them are experienced nearly every type of storm that traverses the Atlantic toward Europe. Unlike the sub-area of the mountains to the westward, that of the plains is favoured with an abundant rainfall which renders the great expanse fertile in nearly all its sections. The growths of the tropics flourish in the south, and productiveness marks its various climatic zones until the vast pine forests of the north define the agricultural limits. The contrast between the two sub-areas is extraordinary, yet their widely different conditions are easily accounted for when their respective meteorological aspects are studied. The Gulf of Mexico, with its accumulation of tropical waters, plays a very important part in creating the prevailing weather conditions of the sub-area of the plains. From it flows a continuous current of warm humid air, which supplies moisture and energy to the storms that descend from the regions of the north-west into the great river valleys. It is the cradle of the equatorial current that sweeps across the ocean far into the Arctic seas, carrying warmth and verdure to latitudes in Europe far north of the general habitable limit on the American continent. But it is unnecessary to do more than refer to so familiar a region in describing briefly the natural subdivisions of the field of observation.

For the Atlantic, like the Pacific, we have the dividing line of the equatorial current of the Gulf Stream. North and west of that line the surface temperature is low, south and east of it very uniform, and along it high. Air in motion over these surfaces is consequently affected by rapid variations of temperature, which affect in turn the energy of the disturbances traversing the atmospheric volume.

A very marked effect of this kind is produced when storms leave the Nova Scotia coast, and at once commence to pass over the equatorial and Polar counter currents. The pressure falls rapidly, and great gales are induced, but the storm seems to be held for several hours over the region between Nova Scotia and Newfoundland, as if controlled by forces which it strove to overcome. When fairly past Cape Race the movement of the storm is no longer interrupted by the influences of the currents, and makes a very uniform progress towards Europe. When cyclonic storms reach the Florida or Carolina coasts from the Gulf of Mexico their energy seems to be increased when passing over the Gulf Stream, but their courses are not altered very much by the influence of that current. This is probably due to its narrowness when passing along the coast to latitude 35°. Eastward of the Gulf Stream, and over the oceanic region of uniform surface temperatures the energy of the storms decreases somewhat, and the areas of their depressions increase. But on approaching the west coasts of Europe the storms again resume their forces and deposit heavy rains. Europe, like America, is divisible into two sub-areas, one of mountains and the other of plains. The eastern limit of the former is that of a line following the Scandinavian Mountains toward the Alpine development into Saxony, thence following the Carpathian mountain outline, and passing southward over Bulgaria and the Balkans to the Syrian mountains. The irregularity of such a dividing line is very apparent, but we may assume that given to be correct enough for our purposes. In crossing the Scandinavian Mountains, Atlantic storms invariably deposit a great rainfall over Norway and pass into the Gulf of Bothnia and Eastern Russia with a reduced precipitation. When on the great Muscovite plains the storms again increase in area, just as they do in the valley of the Mississippi after crossing the Rocky Mountains in Montana; the break in the dividing-line between the sub-areas of mountain and plain in Europe represented by the Baltic and the low lands of Northern Germany, forms a storm gateway to the interior plains, which is frequently passed by Atlantic disturbances. The mountain systems of Switzerland, Italy, and the Balkan peninsula, perform important parts in modifying the conditions during storm movements in Northern Europe, and have each their peculiar local influences on the weather. If these mountains did not form barriers between the regions of great evaporation with their humid winds from the south, and those of Northern and Central Europe, a parallel between the meteorological phenomena of the Mississippi Valley and those of Eastern and Southern Russia in Europe could be drawn very easily. Having now roughly sketched the field of observation at present available, and suggested here and there a few points worthy of special consideration, I will endeavour in the next article to explain how storms move over the several sub-areas, and the changes they undergo in each.

JEROME J. COLLINS

(To be continued.)

NEWCOMB'S ASTRONOMY

Popular Astronomy. By Simon Newcomb, LL.D., Professor U.S. Naval Observatory. (London: Macmillan and Co., 1878.)

A WORK on popular astronomy by an author so distinguished in the higher branches of the science as Prof. Newcomb, will be welcomed with more than ordinary interest. The main object of the present volume is to present the general reader with a condensed view of the history, methods, and results of astronomical research, especially in fields of most popular and philosophical nature at this epoch, in such language as to be intelligible without mathematical study; it has not been designed to instruct either the professional investigator or the special student of astronomy.

In his first chapter the author briefly treats of the phenomena of diurnal motion, the motion of the sun amongst the stars, the precession of the equinoxes, of the moon's motion, and of eclipses of the sun and moon, concluding with some account of the calendar. In his

second and third chapters the true or Copernican system of the universe is described, the obliquity of the ecliptic, the seasons, &c., according to this system, the Keplerian laws of planetary motion, and progress from Kepler to Newton. The latter of these chapters is devoted to Newton's discovery of universal gravitation and consequences flowing from it; the gravitation of small masses, the figure and density of the earth, the tides, the inequalities in the motions of the planets produced by their mutual attraction, and the relation of the planets to the stars. The three chapters form the first part of the work, or "the history of the world historically developed."

The second part is devoted to practical astronomy, the telescope and the successive improvements and modifications introduced in its construction and application down to the present day. The cumbrous yet elaborate form in which an instrument, powerful for its time, was used in the middle of the seventeenth century, is well illustrated by an engraving of the great telescope used by Blanchini in the observations whereby he attempted to determine the time of rotation of the planet Venus upon its axis, one of the instruments constructed by the celebrated Campani, mounted in the grounds of the Barbarini Palace at Rome, and extracted from the historical work "Hesperi et Phosphori Nova Phenomena." As specimens of modern optical and mechanical achievement, we have illustrations and descriptions of the great reflectors of the Earl of Rosse and Mr. Lassell, of the Melbourne instrument and the new reflector in the grounds of the Observatory of Paris. The great refractor of the Naval Observatory of Washington is represented in the frontispiece—a reduction from the picture forming one of the series in the last volume of Washington Astronomical Observations; the instrument with which observations have been made that have afforded us the first really satisfactory knowledge of the elements of the orbits of the four satellites of Uranus and the satellite of Neptune, and what is of still greater interest, the instrument with which Prof. Asaph Hall has brought to light the two minute satellites of Mars, a discovery justly characterised by Leverrier as one of "the most important observations of modern astronomy." The application of the telescope to celestial measurement, the meridian circle and its use, the determinations of time and of terrestrial longitudes, are also considered, and the author proceeds to treat of parallax in general, and in particular of the investigation of the solar parallax, through the intervention of the parallax of one of the planets Venus and Mars when nearest to the earth. Prof. Newcomb supplies a sketch of progress and results in this direction from the first application of the method to the planet Mars, on occasion of the French expedition in 1671, when Richer was sent out to the colony at Cayenne, in South America, to secure observations of Mars, while corresponding observations were made at the Observatory of Paris, from the discussion of which observations Cassini made what is usually given as the first reliable approximation to the amount of the sun's parallax, the resulting value being $9''.5$. The author, however, remarks upon the determination made by Huyghens at the end of his "Systema Saturnium," as the best of the seventeenth century, the reason, as he states, of its being the best being that it was not founded on any attempt to measure the parallax itself, which was then really incapable of measurement, but on the probable magnitude of the earth as a planet. The idea of Huyghens was that the earth, being a planet, its magnitude would probably be somewhere near that of the average of the two planets on each side of it, viz., Venus and Mars. So, taking the mean of the diameters of Venus and Mars, and supposing this to represent the diameter of the earth, he found the angle which the semi-diameter of the supposed earth would subtend from the sun, which would be the solar parallax. By a fortunate accident, Prof. Newcomb remarks, Huyghens's estimate was nearer the truth than any determinations made previous to the transit of Venus in 1769, "his result for the distance of the sun being 25,086 semi-diameters of the earth, or 99,000,000 of miles." But it is to be noted that if Huyghens had used the correct measures of Venus and Mars, he would have been further from the truth; his telescopes showing the planets with diameters in excess of the true ones, "he just hit the diameter of the earth, and reached the true solution of the problem." This attempt of Huyghens to ascertain the amount of solar parallax, is not often mentioned in our astronomical treatises.

The section bearing upon investigations of the solar parallax from transits of Venus, though brief, contains some interesting facts; the proceedings of the American expeditions for the observation of the transit of 1874, are particularly noticed. It appears that the stations finally occupied by the observers sent out from the United States were, Wladiwostok, in Siberia, Pekin and Nagasaki, Japan, in the northern hemisphere, and Kerguelen Island, Hobart Town, and Campbelltown, Tasmania, Queenstown, N.Z., and Chatham Island in the opposite one. The American astronomers relied chiefly upon the photographic method of observing the transit, as possessing obvious advantages over the old method of noting the contacts, and the author describes and illustrates by a diagram, how by the use of a telescope of great length—nearly forty feet—difficulties in the measurement of the photographs were sought to be obviated by the French and American parties, as well as by Lord Lindsay. With regard to the success attending the American expeditions, Prof. Newcomb, (who it may be remarked was one of the principal agents in the arrangement of their equipment and plans of observation) states that the full number of photographs expected was not obtained at any station—but that the result taking the stations collectively, was about half this number; the British, French, and Russian expeditions were about equally successful, while the most fortunate, as regards weather, were the German parties who were successful at all six of their stations. He adverts to the amount of labour attending the investigation and measurement of the photographs, and with respect to the time when a final result may be expected to be worked out from the observations of the transit of 1874, having in view the comparison of the whole to ascertain how consistent they are with each other, adds: "this cannot be done for several years," yet that upon the question whether it is worth while to send out parties to observe the transit of 1882, which must soon be a subject of discussion among astronomers, the answer must depend very largely on the success of the

efforts made in 1874. We should be inclined to hope, however, that the results of Mr. Gill's expedition to Ascension, with Lord Lindsay's heliometer, for observations of the recent close opposition of the planet Mars, may very materially facilitate a decision upon this point. If, as many practical astronomers have anticipated, an equally reliable determination of the sun's distance can be obtained from measuring heliometrically the diurnal parallax of Mars at those oppositions when he approaches nearest to the earth, as from the observation by the combined exertion of civilised nations, of a transit of Venus, then it may be reasonably expected that a method admitting of comparatively such frequent repetition, and involving also so small an outlay, not only as to cost, but labour of preparation, must be preferred by astronomers generally, thus facilitating a proper conclusion with respect to expensive preparation for observing the transit in 1882.

After briefly describing other methods of approximating to the amount of solar parallax which have been applied, including M. Cornu's determination from measurement of the velocity of light and Leverrier's results from the planetary theories, and the method first suggested by Prof. Galle, by measuring the parallax of the small planets, a method which, in a modified form, was applied with so much success on the occasion of the near opposition of Juno in 1874, Prof. Newcomb sums up results by stating that "from the general accordance of the various methods described, it would appear that the solar parallax must lie between pretty narrow limits, probably between 8″·82 and 8″·86, and that the distance of the sun in miles probably lies between the limits 92,200,000 and 92,700,000." This, however, it must be observed, appears to have been written before any of the results of the transit of Venus were published, as the author expresses the hope that after their discussion the uncertainty may be brought within yet narrower limits.

The chapter concludes with an outline of the various investigations of stellar parallax, the most trustworthy values being collected in a tabular form at the end of the volume, and the same has been done as regards successive determinations of the mean parallax of the sun. By thus avoiding the introduction of any considerable amount of numerical detail into the text, the volume is rendered much more readable; indeed, in this respect we may remark, once for all, that the author's arrangement leaves nothing to be desired.

The second part of the work further includes chapters on the motion of light as measured by celestial observations, and experimentally on the methods devised or practised by MM. Foucault, Fizeau, and Cornu; the application of the revolving wheel is explained. A brief outline of the principles of spectral analysis as applied to the heavenly bodies is presented in conclusion. With reference to doubts which have found expression at times as to the degree of certainty attaching to some of the inferences drawn from spectroscopic observation, and remarking that the dark and bright lines in the spectrum are "the letters of the open book which we are to interpret so as to learn what they tell us of the body from which the light came, or the vapours through which it passed," the author introduces the question, How do we know but that the lines we observe may be produced by other substances besides those which we find to produce them in our laboratories? May not the same lines be produced by different substances? The answer to this question can only be founded upon an appeal to probabilities. "The evidence in this case is much the same as that by which, recognising the picture of a friend, we conclude that it is not the picture of any one else. For anything we can prove to the contrary, another person might have exactly the same features, and might, therefore, make the very same picture. But, as a matter of fact, we know that practically no two men whom we have ever seen do look exactly alike, and it is extremely improbable that they ever would look so. The case is the same in spectrum analysis. Among the great number of substances which have been examined with the spectroscope, no two give the same lines. It is therefore extremely improbable that a given system of bright lines could be produced by more than one substance." Nevertheless, it is remarked that the evidence of the spectroscope is not necessarily conclusive in all cases. In the case of a single line only of a substance being found in the spectrum of a star or nebula, it would hardly be safe to infer from this alone that the line was really produced by the known substance, In such doubtful instances collateral evidence must be allowed its weight, and conclusions must be drawn with care and discrimination, in accordance with the probabilities of each special case.

The third part of the work is devoted to a description of the sun and planets, the comets and meteors. The author has had the advantage of outlines of the views of several distinguished students of the physical constitution of the sun, which he presents in their own words. These include notes by Father Secchi, M. Faye, and Prof. Young. On the subject of intra-mercurial planets he remarks upon the fact of suspicious objects thus far having been seen only by amateur observers, and escaping the skilled astronomers who have occupied themselves in watching the sun's disc, and appears to consider that this circumstance places their real existence beyond moral probability. He favours the idea that if the motion of the perihelion of Mercury be due to the action of a group of planets, they are each so small as to be invisible in transits across the sun, and during total eclipses, and yet being so large in the aggregate, their number must be counted by thousands, and if seen at all they would appear only as a cloud-like mass. The zodiacal light offers this aspect, and the question arises whether the matter which reflects this light can be that which affects the motion of Mercury, and Prof. Newcomb is rather in favour of this explanation, though, he adds, "a great deal of research—more, in fact, than is likely to be applied to the subject during the present generation —will be required before the question can be settled."

The fourth part treats of the stellar universe, the second chapter on the structure of the heavens meriting especial attention. Space will not allow of our entering in detail upon the contents of this last portion of the volume; it concludes with an expression of the author's ideas relative to the much-discussed question of the Plurality of Worlds. This last part will probably possess greater interest for many than the rest of the work, though necessarily entering upon subjects not yet removed from the region of speculation. Prof. Newcomb,

however, does not mix up what is merely speculative with well-established conclusions in such way as to mislead his readers who may be entering upon the study of astronomy—a failing of too many works issued at the present day.

As affording a thoroughly reliable foundation for more advanced reading, Prof. Newcomb's "Popular Astronomy" is deserving of strong recommendation.

J. R. HIND

SLATE AND SLATE QUARRYING

A Treatise on Slate and Slate Quarrying, Scientific, Practical, and Commercial. By D. C. Davies, F.G.S. (London: Crosby Lockwood and Co., 1878.)

AMONGST the manufacturing industries which, during the last hundred years, have expanded into large proportions is the production of roofing slate. Nor is it difficult to account for this expansion. Building operations have in this period progressed both over town and country, both in the Old and New World with extraordinary rapidity, while canals and railroads have facilitated the transport of the roofing slates from their mountain sources to all parts of the land, and ships traverse the seas with cargoes of the same material to various countries. Before the introduction of canals and railways into the British Isles, the slates of Wales, Cumberland, Scotland, and Ireland were restricted to the immediate neighbourhood of the quarries from which they were extracted, and buildings in various parts of the country far removed from these quarries, were supplied with roofing materials from other sources. In many districts tiles of burnt clay formed the only available material, while in others, flag-stones and tile-stones from the Carboniferous, Triassic, or Oolitic formations were extensively used. In the eastern and central districts of England the tile-stones of Stonesfield, near Oxford, those of the Cotteswold Hills, and of Collyweston formed an available source of supply; and it must be admitted that their greyish colour and general appearance harmonise well with the prevalent Gothic or Tudor styles of architecture of those districts. To such an extent is this admitted that these tilestones (erroneously called "slates") are still largely used in the counties of Northampton, Oxford, and Gloucester, even when the Welsh slate might be obtained at an equal or less cost, and, owing to their heaviness, the high-pitched roofs, which are so ornamental, and add so much to the appearance of buildings, became a necessity. Nevertheless, the Oolitic tilestones are inferior in strength, lightness, and durability to the latter material, and are only used where æsthetic considerations prevail over those of economy.

In no country of equal extent has the art of slate-quarrying reached such proportions as in the British Isles, and especially amongst the mountains of North Wales, which is its principal seat; and considering the magnitude of the works carried on, the large number of persons employed, and the enormous sums made and lost in this branch of trade, it is somewhat strange that no work specially devoted to the subject of slate quarrying has appeared up to this time. We therefore welcome Mr. Davies' little treatise, in which will be found a large amount of interesting and valuable information regarding the slate industries of North Wales and other districts, gathered from much experience and observation, and placed before the public in a very readable form.

Mr. Davies, being a geologist, treats his subject geologically, recounting the various formations of North Wales in which the various "veins" or beds of the best slates are to be found; and giving numerous details, often illustrated by sketches of the stratigraphical phenomena which are encountered in the quarries. Few people have any idea of the physical impediments which occur in such places. What with dykes, veins, slips, the disappearance of cleavage planes, the local change in texture and composition of the slate itself, and other disturbances and "troubles," it is only a comparatively small proportion of the entire slate-bed which can, even in the best quarries, be converted into marketable slates, of the larger sizes and qualities, known as "Princesses," "Duchesses," and "Countesses." Hence it is, that while a band of slate-rock, in a favourable position for carriage, and comparatively free from such impediments to its useful application, is a source of profit, another band, which is not so free from these accidents of stratification, remains a profitless, or ruinous possession.

Commencing with the oldest formation of North Wales, the Lower Cambrian of Prof. Sedgwick, Mr. Davies describes the eminently successful quarries opened in this formation in the Pass of Llanberris, which have proved a source of untold wealth to their fortunate owners. The slates from this formation are generally purple or greenish —locally becoming greyish—and are amongst the smoothest and strongest in Wales. The succeeding formations of the Upper Cambrian and Lower Silurian are also productive of slates—generally of bluish and dark tints—and are worked over the central portions of the mountain region. The value of such beds of slate depends chiefly upon the uniformity and fineness of the grain of the slate, and the facility with which the rock splits along the planes of cleavage—which, as all geologists are aware, are independent of those of bedding. In reference to the origin of the cleavage structure, we are glad to find that the author adopts the "mechanical theory," which ascribes the structure to the enormous lateral pressure to which the rocks have been subjected when undergoing contortion; but in enumerating the observers who have contributed towards our knowledge on this subject, he has omitted the name of the late Mr. Daniel Sharpe, whose remarkable papers published in the *Journal* of the Geological Society (vols. iii. and v.), clearly established the relationship between cleavage and pressure, and the structural alterations which have been brought about within the mass of the slate-rock itself, as subsequently confirmed and illustrated by Mr. Sorby, after the microscopical examination of thin sections.

The author's notices of slate-production in districts other than those of North Wales are scanty, and consist of extracts from other works. His book is, therefore, mainly valuable for the information it affords regarding the position, structure, and mode of working the bands of slate in the lower palæozoic formations of North Wales; and as such it will be found a useful guide-book.

OUR BOOK SHELF

Familiar Wild Flowers. Figured and Described by F. E. Hulme, F.L.S., F.S.A. With Coloured Plates. Parts I.-XIII. (London: Cassell, Petter, and Galpin.)

THERE has certainly been a wonderful improvement of late years in the art of chromo-lithography as applied to botanical illustrations; and the specimens in the work before us are among the best that we have seen. The colouring, the outline drawing, and the general representation of habit, are all remarkably true to nature. The floral initial letters and tail-pieces, which are stated to be drawn "by various artists," are not so uniformly successful. Each part, published at the remarkably low price of sixpence, contains two coloured plates, more than one species being occasionally placed on a plate. The accompanying letter-press descriptions, though rather shorter than would in many cases be desirable, are written in plain and easy and not too technical language. There is no indication of the proportion of the British flora intended to be included under the designation of "familiar wild flowers;" but whenever the volume is completed, it will be a useful addition to our popular botanical literature, and well calculated to promote an accurate knowledge of the common plants of our fields and hedges.

Heroes of South African Discovery. By N. D'Anvers. (London: Marcus Ward and Co., 1878.)

The Countries of the World. By Robert Brown, M.A., Ph.D., &c. Vol. ii. (London: Cassell. No date.)

The Life of Sir Martin Frobisher. By the Rev. Frank Jones, B.A. (London: Longmans, 1878.)

THERE seems to be no end to the number of geographical works published nowadays. Mr. D'Anver's work is a companion volume to "Heroes of North African Discovery," by the same author, already noticed by us. Like its predecessor its numerous pictures and the many adventures of the "heroes" of its pages will render it attractive reading for boys, who, if they read it faithfully, will carry away with them much valuable information. The work does not pretend to anything like minute research, but so far as it goes, it is, we believe, trustworthy.

The present volume of Dr. Brown's work, which may be taken as a typical specimen of Messrs. Cassell's showy popular publications, deals mainly with the United States and Mexico. Dr. Brown has taken considerable trouble to obtain varied information concerning the different States, and his account of them is fairly full and accurate. In a work like this he cannot be blamed for repeating the oft-told story of his adventures in the west and north-west, though the style, rather than the stories, pall somewhat on one. The pictures, we believe, may be taken as on the whole what they purport to be; though it is curious to notice the uniformity of Nature under different conditions, and at widely separated places. One of the illustrations connected with Mexico is entitled a "Lagoon in the Sierra Calientes." Dr. Brown will be interested to know that an exactly similar scene is pictured as occurring on the banks of the Ucayli in South America, in "Paul Marcoy's" Travels; but as it is doubtful if "Paul Marcoy" was ever many miles from Paris, the "Scene on the Ucayli" may be as mythical as his "Travels."

Judging from the formidable list of authorities given by Mr. Jones, his life of the rough, but brave and even chivalrous old Frobisher must be the result of much research. Mr. Jones seems, however, to be entirely deficient in literary skill; his materials have been put together in the crudest manner possible. Though Frobisher added little to geographical knowledge, he deserves a place among the heroes of the North-West Passage for his three attempts to discover it. Unfortunately the object of his last two expeditions was to bring home shiploads of the "black earth" which people had been deluded into believing was rich in gold, and all Frobisher's efforts at discovery were balked. His life deserved to be written, but we cannot say that Mr. Jones has shown himself competent for the task.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Telephone

THE following experiments lately made as to the use of the telephone in connection with a magneto-electric machine, have given results which are somewhat interesting.

In the first instance a small medical magneto-electric machine was employed with the result (described by Mr. A. Percy Smith, NATURE, vol. xvii. p. 380), of a loud click at each rotation of the bobbins in front of the magnet. Driving the former by means of a small turbine, the clicks combined to form a loud musical note which rose and fell as the speed of rotation was increased or diminished. This note was well heard through a resistance of 32,000 units.

A magneto-electric exploder having two horseshoe magnets, four bobbins, and two rotating armatures was next employed. This gave a loud sound through 57,000 units of resistance. With a view to test the power of the machine to work through bad insulation, it was tried through about thirty yards of bare copper wire lying on wet grass. The sound was still powerful.

A break was then made in the line by cutting it across and dipping the two ends in a fountain basin filled with water. The two ends in the water were about twelve feet apart, and the sound was still perfectly audible. It was found in this experiment that it was *not* necessary to connect the magnetic exploder to earth, and that a sound feebler, but quite distinct, was obtained when *only a single wire was led from it.* The line was thus from exploder through twelve feet of water to telephone, the other binding screw being connected to a wire simply touching the wet gravel, there being therefore no return line.

Again the exploder and telephone were connected to a stretched wire belonging to a fence, at a distance apart of about fifty yards. The wire was supported by fifteen intermediate iron uprights with their ends buried in the ground. Earths were made for the telephone and exploder by means of a clasp knife and a little garden fork. A perfectly distinct sound was heard.

Lastly, one terminal of the exploder and telephone were connected by a wire, the others being joined by a length of twenty-four feet of thin string dipped into river water and subsequently drawn through a dry cloth. An audible sound was noticed.

The above experiments seem to point to two conclusions:—

1. That magneto-electric currents can be employed through exceedingly defective insulation, almost no insulation, in fact.

2. The omission of the earth connection of the exploder seems to indicate that the production of the sound is due either to a very slight leak from the exploder to earth—the machine was inclosed in a wooden box standing on a wooden table—or, not impossibly, to the rapid variation of potential in the line.

In the way above indicated it would appear to be possible to transmit the Morse code by means of magneto-electric currents under conditions which would render a battery absolutely inapplicable.

GEORGE S. CLARKE
HERBERT MCLEOD

Cooper's Hill, April 17

Poisonous Australian Lake

PERHAPS some of your readers may be interested in the following:—

This year the lakes forming the estuary of the Murray have been very low and the water unusually warm. The river is very low and the inflow to the lakes very slight and having a temperature of 74° F. Lake Alexandrina—on calm days surface

76°, depth 73°—during breezy temperature is 72°. A conferva that is indigenous and confined to the lakes has been produced in excessive quantities, so much so as to render the water unwholesome.

It is, I believe, *Nodularia spumigera*, allied to protococcus. Being very light, it floats on the water except during breezes, when it becomes diffused. Thus floating, it is wafted to the lee shores, and forming a thick scum like green oil paint, some two to six inches thick, and as thick and pasty as porridge, it is swallowed by cattle when drinking, especially such as suck their drink at the surface like horses. This acts poisonously, and rapidly causes death; symptoms—stupor and unconsciousness, falling and remaining quiet, as if asleep, unless touched, when convulsions come on, with head and neck drawn back by rigid spasm, which subsides before death. Time—sheep, from one to six or eight hours; horses, eight to twenty-four hours; dogs, four to five hours; pigs, three or four hours.

A *post mortem* was made on a sheep that had thirty ounces of fresh scum administered by the mouth: death was long coming on—about fifteen hours; examination made six hours after. Stomachs: none of the green scum left, all absorbed; dry grass food in stomachs. Abdominal cavity contained two pints of yellow serum; heart flaccid, but not pale; great effusion of serum around it. Lungs, liver, kidneys, and substance of brain healthy and normal, but the dura mater congested. Blood throughout veins and arteries and in both ventricles black and uncoagulable, neither did it become scarlet on exposure to the air. Many sheep that died, on being opened, presented the same appearances, all being without any sign of its presence in the stomachs.

This shows that the plant is rapidly absorbed into the circulation, where it must act as a ferment and cause disorganisation. The cattle will not touch the puddles where the scum has collected and gone putrid. Thus all they take is quite fresh, and the poisoning is not caused by drinking a putrescent fluid full of bacteria as at first supposed. When this scum collects on the banks and is rapidly left dry, it forms crusts of a green colour. This has gone out of the Murray mouth into the ocean and been wafted ashore, forming thick beds of green stuff from a few inches to twelve inches thick. When, however, this scum is left in wet pools and puddles it rapidly decomposes, giving off a most horrid stench like putrid urine, or archil in process of manufacture; but previous to its getting into that state it emits the smell of buytric acid, smelling like very rancid butter.

There exudes from this decomposing matter a blue pigment which has remarkable properties. Sample tube I contains the fluid as strained off from the scum and will be found full of bacteria. No. 2 is the same with glycerine, and filtered to separate the bacteria.

This fluid is remarkably red, fluorescent by reflected light, being blue by transmitted light. Spectrum a broad and deep band total at top in the red, but shading off to green, quite cutting off orange and yellow.

Chemical properties:—Heat destroys colour; sulphuric acid no action; nitric acid reddens; hydrochloric acid, the alkalis, and ammonia, destroy colour; chlorine and ozone bleach; light but little action, yet sunlight gradually bleaches; dries to a mass, retaining colour; soluble in water, glycerine, and weak alcohol. I think this is allied to the colouring matter of some lichens, is a product of decomposition, and not pre-existing in fresh plants. Its fluorescent powers are remarkable, and the most powerful I have ever met with. GEORGE FRANCIS

Adelaide, S. Australia, February 11

Transmission of Vocal and other Sounds by Wires

THE following are notes of some additional experiments since those recorded in my paper laid before the Physical Society of London, an abstract of which appeared in NATURE of 25th inst.

1. An ordinary iron fence railing was selected containing six lines of wires varying from $\frac{3}{16}$ to $\frac{1}{4}$ inch in thickness. These wires were passed through iron supports at every *two yards*. A disc, mouth and ear-piece, was attached to one of the wires when speaking, singing, whistling, and breathing were transmitted through distances varying from twenty to sixty yards, whilst the sound of a small tuning-fork was heard at 100 yards.

2. In an iron fence, with heavy iron top-rail, half inch square in section, and having iron supports at *every yard*, it was found that the above-mentioned sounds could be transmitted through about thirty yards; the tuning-fork sound, however, was heard at sixty-six yards.

In the latter experiment the best results were got with a hollow wooden mouth-piece, pressed against the iron, the ear being connected with the iron by means of a solid body, such as a cork.

3. Some yards of No. 16 copper wire were attached to the ordinary bell-wire connection from one room to another; another portion of the same copper wire was attached to the brass bell crank in another room—a lobby intervening;—speaking, singing, and other sounds were readily transmitted; the tone was low, but clear.

For this experiment the terminal discs were of pasteboard, set in metal rims.

In the experiments with the iron fence, the sounds were free to pass not only up and down the particular wire selected, thus necessarily *doubling* the range of distance given above, but suffered breaking up at each support, and consequent distribution through the other wires.

Glasgow, April 27 W. J. MILLAR

Westinghouse Brake

THE experiment shown by the Westinghouse Brake Company was described by Sir W. Armstrong as long ago as 1843, in a paper "On the Efficacy of Steam as a Means of Producing Electricity and on a Curious Action of a Jet of Steam upon a Ball" (*Phil. Mag.* xxii.). The explanation of the phenomenon as due to the centrifugal force of the diverted jet is given in general terms in Young's "Lectures on Natural Philosophy" (Lecture xxiv. p. 297). R.

April 28

The Oxford Commissioners' Statement

MAY I be permitted to draw attention to the very marked discrepancy between the arrangements proposed by the University of Oxford Commissioners for the Animal and for the Vegetables side of Biology? Assuming, as we fairly may, that by "Physiology" the Commissioners mean Animal Physiology, and supposing—what is by no means improbable—that the future Reader in Invertebrate Anatomy would refuse the Professorship of Zoology; when that office is next vacant, we see that there would be *four* University Professors (or Readers) of Animal to *one* of Vegetable Biology; while we may also note that at Christ Church there is a Reader in Anatomy, and that at no College is there any Reader in Botany.

When the efforts, which may fairly be described as violent, to effect the removal of the Botanical Gardens to a peculiarly objectionable site failed, it was hoped that those who, wittingly or unwittingly, endeavoured to paralyse the study of Botany in this place, would have yielded fairly.

The suggestions now made lead us to fear that the Commissioners have been persuaded to do what the University would not do.

At any rate, if the matter is too delicate for the Professor of Botany to deal with, it is to be hoped that other Botanists will make proper representations to the University Commissioners.

April 27 B.

Contact Electricity

IF a Volta's condenser be formed of an iron and a copper plate having their surfaces of contact well ground together, it is found that, on placing them together and then separating them, the iron acquires a positive charge and the copper a negative. This occurs so long as the atmosphere surrounding the plates is the ordinary one containing watery vapour and other oxygen compounds. But if the atmosphere contain sufficient hydrogen sulphide, the iron will be found negatively and the copper positively electrified. Sir Wm. Thomson has shown that "a metal bar insulated so as to be movable about an axis perpendicular to the plane of a metal ring made up half of copper and half of zinc, the two halves being soldered together, turns from the zinc towards the copper when vitreously electrified, and from the copper towards the zinc when resinously electrified."

Substituting for the zinc half of ring an iron half, the same effect takes place, but in a less degree; but if the ring be

surrounded by an atmosphere containing sufficient hydrogen sulphide, the opposite effect occurs. Now the needle, when vitreously electrified, turns from copper to iron; when resinously, from iron to copper. The conclusion to be drawn from these results seems to be that the electrical behaviour of metals in contact is almost, if not entirely, due to the difference of their affinities for one of the elements of such compound gases as may be in the atmosphere surrounding them. This would be entirely analogous to their behaviour in electrolytes containing these same elements, *e.g.* iron is positive to copper in an oxidising electrolyte such as water, because of the affinity of oxygen for iron being greater than for copper, while iron is negative to copper in potassium sulphide solution, because of the affinity of sulphur being greater for copper than for iron. J. BROWN

Edenderry House, Belfast

Solar Halo

THE following was noticed at Bordeaux on April 4, at 11 A.M:—1. A well-defined and very complete circumzenithal circle (80° in diameter), of a brilliant white light, passing through the sun. 2. An iridescent circle, larger than the first, and cutting it at two points 60° distant from the sun. The second circle showed more especially the red rays on its concavity (*i.e.* towards the sun), except at the parhelia, where it was bright iridescent. Near the western parhelion the brilliancy of the mock sun was quite insufferable to naked eyes.

The morning was very warm, but the night had been very cold. E. RODIER

29, Rue Saubat, Bordeaux, April 20

FLOATING MAGNETS

THE extract from the *American Journal of Science* describing experiments with floating magnets by Mr. Alfred M. Mayer to illustrate the equilibrium of mutually-repellent molecules each independently attracted towards a fixed centre, which appeared in NATURE, vol. xvii. p. 487, must have interested many readers.

It has interested me particularly because the mode of experimenting there described, with a slight modification, gives a perfect mechanical illustration (easily realised with satisfactory enough approximateness) of the kinetic equilibrium of groups of columnar vortices revolving in circles round their common centre of gravity, which formed the subject of a communication I had made to the Royal Society of Edinburgh on the previous Monday. In Mr. Mayer's problem the horizontal resultant repulsion between any two of the needles varies according to a complicated function of their mutual distance readily calculable if the distribution of magnetism in each needle were accurately known. Suppose the distributions to be precisely similar in all the bars and in each to be according to the following law:—Let the intensity of magnetisation be rigorously uniform throughout a very large portion, C D, of the whole length of the bar (Fig. 1), and let it vary uniformly from C and D to the two ends A and B. The bar will act as if for its magnetism were substituted ideal magnetic matter,[1] or polarity, as it may be called, uniformly distributed through the end portions C A and D B; the whole quantity in D B to be equal in amount and opposite in kind to that of C A. For example, suppose true northern polarity in A B and true southern in B D. The lengths of C A and D B need not be equal. Let now A′C′D′B′ be another bar with an exactly similar distribution of magnetism to that of A C D B, and let the two be held parallel to one another. The mutual repulsion will vary inversely as the distance, if the distance be infinitely small in comparison with D B or C A, and if each of these be infinitely small in comparison with C D. If the true south pole S of a powerful bar-magnet be held in a line midway between B A and B′A′, at a distance from the ends B and B′ infinitely great in comparison with B B′, and comparable with the length of each needle, the horizontal component of its effect on each magnet will be a force varying directly as its distance from the central axis. Under these conditions Mr. Mayer's experiments will show configurations of equilibrium of two, or three, or four, or any multitude of ideal points in a plane, repelling one another with forces inversely as the mutual distances, and each independently attracted towards a fixed centre with a force varying directly as the distance. This, as I showed in my communication to the Royal Society of Edinburgh, is the configuration of the group of points in which a multitude of straight columnar vortices with infinitely small cores is cut by a plane perpendicular to the columns; the centre of inertia of a group of ideal particles of equal mass placed at these points being the fixed centre in the static analogue.

The consideration of stability referred to by Mr. Mayer has occupied me much in the numerical problem, and it is remarkable that the criterion of stability or instability is identical in the static and kinetic problems. In the static problem it is of course that the potential energy of the mutual forces between the particles, together with that of the attraction towards a fixed centre is less for the configuration of stable equilibrium than for any configuration differing infinitely little from it. The potential energy of the attractive force is a function of distance from the central axis, diminishing as the distance increases, and the statement of the criterion may be conveniently modified to the following:—

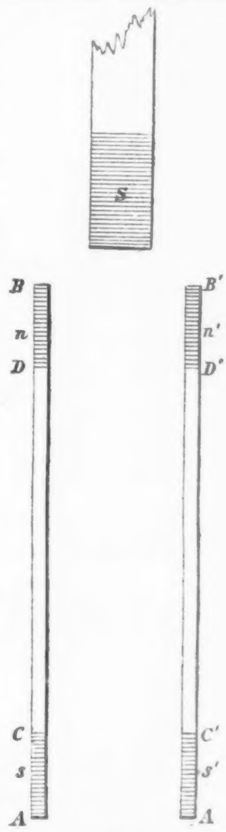


FIG. 1.

For a given value of this function the mutual potential energy of the atoms must be a minimum for stable equilibrium. When, as supposed above, the attractive force varies directly as the distance its potential energy is:—

$$C - \tfrac{1}{2} c \Sigma r^2$$

where C, c, denote constants, and Σr^2 the sum of the squares of the distances of all the particles from the attractive centre. And when the law of force between the particles is the inverse distance, their mutual potential energy is equal to—

$$K - k \log. (D D' D'' \ldots.)$$

where K, k, denote constants, and D, D', D'', &c., denote the mutual distances between the particles. Thus the condition of stable equilibrium becomes that the product of the mutual distances between the particles must be a true maximum for a given value of the sum of the squares of their distances from the attractive centre. A first conclusion from this condition must be that the centre of gravity of the particles must be the attractive centre. Now the condition of kinetic equilibrium of a group of vortex columns, that is to say the condition that they may revolve in circles round their common centre of inertia is, as proved in my communication to the Royal Society of Edin-

[1] Reprint of papers on Electrostatics and Magnetism, § 469 (W. Thomson).

burgh, that the product of their mutual distances must be a maximum or minimum or a maximum-minimum for a given value of the sum of the squares of their distances from the common centre of gravity;[1] and the condition

FIG. 2.

FIG. 3.

that this kinetic equilibrium may be stable is that the product be a true minimum for a given value of the sum of the squares of their distances from the centre of inertia. Taking for example a triad of vortices (or of the little magnetic needles of Mr. Mayer's problem), it is thus obvious the equilibrium is unstable in the case represented by Fig. 2, and stable in the case represented by Fig. 3. The arrow-heads in Figs. 2 and 3 represent the motions of the vortex columns round their centre of gravity. It must be understood that the core of each column revolves also round its centre of gravity in the same direction as the group round the common centre of gravity of all with enormously greater angular velocities.

I have farther considered the problem of oscillations in the neighbourhood of configuration of stable equilibrium. The general problem which it represents for mathematical analysis has a very easy and simple solution for the case of a triad of equal vortex columns in the neighbourhood of the angles of an equilateral triangle.

A mechanism for producing it kinematically is represented in Fig. 4, showing three circular discs of cardboard pivotted on pins through their centres at the angles of an equilateral triangle rotating in a vertical plane. The plane carrying these three centres may be conveniently made of a circular disc of stiff cardboard, or of light wood pivotted on a fixed pin through its centre. Each of the small discs or epicycles is prevented from rotation

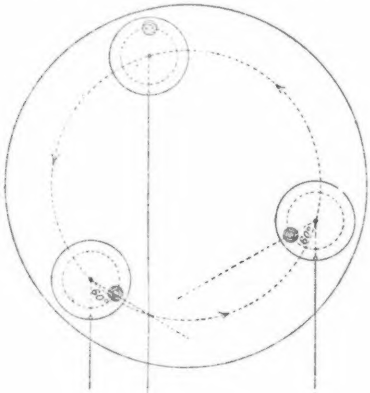


FIG. 4.

by a fine thread bearing a weight, and attached to a point of its circumference; and on each of them is marked, by a small dark shaded circle, the section of one of the vortex cores in proper position.

[1] Helmholtz proved that whatever be the complication of motions due to mutual influences among the vortices, their centre of gravity must remain at rest.

The rule for placing the vortices on their epicycles is as follows:—Each vortex keeps a constant distance from its mean position (this being the centre of the epicycle, carrying it in the mechanism); each of the radius vectors drawn from the centres of the epicycles to the centres of the vortices keeps an absolutely fixed direction, while the equilateral triangle of the centres of the epicycles rotates uniformly; and these three fixed directions are inclined to one another at equal angles of 120° measured backwards relatively to the order in which we take the three vortices. It is easily verified that when the distances of the vortices from their mean positions are infinitely small (that is to say, when the triangle of the triad is infinitely nearly equilateral), the product of its three sides remains constant in the movement actually given by the mechanism, and so does the sum of the squares of the distances of its three corners from its centre of gravity. From the stability of the equilateral triangle it follows[1] that there must be stability with three equal vortices at the corners of an equilateral triangle, and one (whether equal to them or not) at its centre,[2] ∴ For four equal vortices I have found that the square order, ::, also is stable. From the stability of the square follows (for vortices or for particles repelling according to inverse distance) the stability of four equals at the corners of the square, and one (whether equal to them or not) at its centre,[3] ⁙ I have not yet ascertained *mathematically* whether for a pentad of equal vortices there is stability also in the pentagonal arrangement, ⁙ But Mr. Mayer's experiment, showing it to be stable for the magnets, is an experimental proof that it must be stable for the vortices, for it is easily proved that if any of the figures is stable with mutual repulsion varying more rapidly (as is the case with the magnets in Mr. Mayer's experiment), than according to the inverse distance, *à fortiori*, it must be stable when the force varies inversely as the distance. From the stability of the pentagon I infer (for vortices and for particles repelling according to inverse distance) the stability of the configuration ⁙

Mr. Mayer's figure [4] ⁙ shows that the hexagonal order was unstable for his six magnets. I had almost convinced myself before seeing the account of his experiments in NATURE, that the hexagonal order is stable for six equal vortices; and Mr. Mayer's last figure shows that with his magnets the hexagonal order is rendered stable by the addition of one in the centre ⁙

The instability of the hexagon of six magnets shows the simple polygon to be unstable for seven or any other number exceeding six. Thus Mr. Mayer's beautiful experiment brings us very near an experimental solution of a problem which has for years been before me unsolved—of vital importance in the theory of vortex atoms—to find the greatest number of bars which a vortex mouse-mill can have.

WILLIAM THOMSON

[1] In the case of vortices or of the static problem when the law of the mutual repulsions is the inverse distance, but not with the law of repulsion with ordinary proportions of linear dimensions and magnetic distributions, in Mr. Mayer's magnetic arrangement.

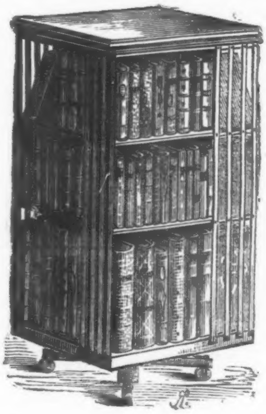
[2] In repetitions of Mr. Mayer's experiments, I have always found this configuration unstable, and for four only the square stable.

[3] This configuration of the floating magnets I have found stable, but with less wide limits of stability than the pentagon.

[4] I have not found this, nor any other configuration than the pentagon with centre, stable for six floating magnets.

A ROTATING BOOK-CASE

WE have received from Messrs. Trübner and Co. a book-case on a novel principle, the invention of an American, the introduction of which, into local museums would, we believe, be attended with considerable advantages. The accompanying woodcut will render a detailed description of it unnecessary, while the practical advantages of storing books in such a small space will be obvious to everybody. We draw attention to it not so much from its use in a private library, to the owners of which it will at once commend itself, as from the convenient manner in which books and specimens supplementing each other, may be arranged in close proximity. We believe that if in a museum geological books, for instance, were thus arranged



by the side of the geological specimens, references to the former would be more often made than they are at present when they have to be consulted often in another room at a considerable distance away. Of course the more valuable books and the special memoirs should find their place in libraries as they exist at present, but a typical collection of books side by side with a typical collection of specimens such as this neat arrangement suggests would, we believe, form a novel feature which would be greatly appreciated by many students. The four sides of the rotating book-case also afford a capital means of dividing the subjects as well as saving space, almost to as great an extent as the rotating case for art illustrations introduced by Sir Henry Cole into the South Kensington Museum.

FAUSTINUS JOVITA MARIANUS MALAGUTI

WE are called upon to chronicle a new loss to French science in the death, on April 24, of the well-known chemist Prof. Malaguti. He was born in Bologna February 15, 1802, his father being a pharmaceutical chemist. At the age of sixteen he completed the course in pharmacy at the Bologna University, and undertook the direction of his father's establishment. Although holding himself aloof from political questions, he became unintentionally involved in the complications of 1831, and was forced to leave his native land. He arrived at Paris unfamiliar with the French language, and succeeded in exciting the sympathies of Gay Lussac, who admitted him into his laboratory as assistant to Pelouze. After finishing a course in the École Polytechnique, he was appointed, in 1843, chemist to the porcelain manufactory at Sèvres. Soon after he received the degree of doctor of science, and in 1850, as the result of a competitive examination, was appointed to the chair of chemistry in the scientific faculty of Rennes, a position which he has since then occupied. In 1855 he was elected dean of the faculty.

As an investigator Malaguti won a prominent place in the annals of French chemistry, the period from 1833 to 1867 being especially fruitful. Devoting his attention to the theoretical dispute of the day, he laboured unweariedly in widening the region of experimental chemistry, showing himself equally at home, not only in the organic and inorganic departments, but also in technical and vegetable chemistry. In inorganic chemistry he devised methods for preparing a variety of metallic oxides, such as cuprous and chromic oxides, in the pure state, and investigated closely the properties of a number of salts and minerals. The extensive occurrence of silver in the blood, in sea-water, coal, salt, &c., as well as the most profitable means of winning the metal, formed subjects for an interesting series of papers in 1849.

In the province of organic chemistry, Malaguti rendered his chief services, his exhaustive studies into the principles of etherification and the action of chlorine on ethers and organic bodies in general being models of careful, thorough work. The enormous mass of facts which he gathered together contributed in no small degree to the establishment of the principle of substitution. Among other important researches in this department should be mentioned the discovery of methylal, the study on the action of acids on sugars, the papers on amides and nitrites, &c.

The influence of soils on the composition of plants was investigated by Malaguti in the most thorough manner, and led to the general conclusion that the constitution of the soil affected the ashy constituents of the plants, but not their physical properties. Equally important was the series of experiments on the division of inorganic matter among the various plant families, on the temperature of the soil and the air, and on the action of various compounds on living plants.

Besides these more purely scientific labours he accomplished no small amount in analytical chemistry, and made some valuable discoveries in practical metallurgy.

In addition to his numerous contributions to the periodical scientific literature, Malaguti published in 1848 "Leçons de Chimie agricole," and in 1853 "Leçons élémentaire de Chimie," a text-book highly regarded in France, and recently honoured with a new edition.

In 1855 he was elected a corresponding member of the French Academy of Science, and in 1860 he was appointed an officer of the Legion of Honour. The Academy of Turin, the London Chemical Society, and several other learned societies, numbered him among their honorary members.

T. H. N.

DR. THOMAS THOMSON, F.R.S.

A SERIOUS and protracted illness had removed Dr. Thomson,—who departed this life on Thursday, April 18,—so long from any very steady participation in the progress of botanical research that, except to those old friends who cherish the memory of his more active days, his name has of late been little before the public. Few, however, have done more permanent work in descriptive botany, in which department of science his information was not only extensive, but unusually accurate, while the range of his acquirements in other branches of natural science was distinguished by a correctness of judgment which, added to no ordinary amount of general knowledge in matters of taste and literature, made him a most delightful and instructive companion. Like many others who have acquired a permanent name in science, he had the advantage of being trained under a scientific father, while his intimate acquaintance with Sir W. J. Hooker, was no small advantage, and not less the having as the constant companion of his youth, Sir Joseph Hooker.

On his entering as assistant-surgeon in India, a great field was open to him, of which he happily availed himself. After a participation in some of the miseries of the Cabul campaign, though not actually serving in the expedition, and a narrow escape, in company with Lady Sale, of endless captivity, he was able to devote his time very much to science. He was employed in 1847 and 1848 in the Tibet Mission, a winter residence at Iskardo, a perilous journey along the portion of the Indus which runs beyond Iskardo, though, from the state of the country, he could not pursue its course to Kashmir, and the results of the previous journey gave him the opportunity of publishing a most instructive volume which, for soundness and multiplicity of information can scarcely be surpassed.

Dr. Thomson joined his friend Dr. Hooker in Darjeling in the end of 1849, after the completion of his arduous journeys in the North-West Himalaya and Tibet, and they spent the rest of the year 1850 in travelling and collecting, returning to England together in 1851. Having obtained permission from the Indian Government to distribute his botanical collections, which were equal in extent and value to those of Dr. Hooker, after taking part in the preparation of the Indian Flora, he returned to India as Director of the Botanical Garden at Calcutta. On his return to England, increasing infirmity soon made him unequal to any constant participation in the work, but up to a very few weeks before his death he was employed as examiner, his qualifications for which made him a most desirable and efficient colleague. Though in a very failing state of health, he collected last summer assiduously in the neighbourhood of Pitlochrie, and was so fortunate after three times ascending the Sow of Atholl as to rediscover the long-lost *Menziesia cærulea*. It remains only to add that his kind and affectionate disposition endeared him to all who knew him, and to none more than to the writer of this short and imperfect notice. M. J. BERKELEY

THE GREENLAND ESKIMO

A COMMISSION was appointed by the Anthropological Society of Paris to examine the Eskimo whom M. Geoffroy St. Hilaire, the intelligent director of the Jardin d'Acclimatation has brought from Greenland. This Commission was composed of MM. Broca, Dally, Girard de Rialle, Topinard, Masard, and Bordier (*rapporteur*). The following are the details which I have given to the Society as the result of the observations made by the Commission.

The Greenlanders, whom all Paris has been to see at the Jardin d'Acclimatation, are six in number, viz., Okabak, thirty-six years; Majak, Okabak's wife, twenty-three years; their two daughters, Anna, twenty-five, and Catarina, thirteen, months; Kojank, twenty-three years; and Jokkik, forty-one years, who is recognised at once as a half-breed between Dane and Greenlander.

These Greenlanders came from Jacobshavn, on Baffin's Bay, on the west coast of Greenland, about 69° N. lat., not far from Disco Bay and Island. In that latitude the temperature in winter falls as low as $-49°$ C. It differs notably from that which has to be endured by other Eskimo whose habitat extends to the south of Greenland, from Labrador to Behring Strait.

Jacobshavn, although belonging to the north district of Greenland, is not, however, the most northern town; for Bessels has given, as the human habitat nearest to the pole, the town of Ita, in 78° 16′ N.; Ita appears, however, to be only a summer station. At Disco Bay the sun does not rise from November 30 to January 15. It may not be useless to give a rapid glance at the surroundings in the midst of which these Greenlanders live.

The flora is rudimentary. The Greenlanders have but little wood at their command; the little they use is imported from Denmark.

The fauna, less poor, is composed, first of all, of the seal, which constitutes the prime material of all their

FIG. 1.—1 and 2. Toy dog and seal, cut in wood. 3. Knife to scrape fat off seal-skins. 4. Seal-skin hunting girdle with ivory medallion. 5. Seal-skin pouch. 6. Obsidian lamp. 7. Bone fish-hooks with iron points. 8. Tuft for catching vermin.

civilisation—food, light, heat, clothing, boat-building, various implements and utensils—the seal furnishes all. The white bear is sought for its fur, but the flesh seems to be reserved for the dogs. The reindeer is also found in Greenland. According to Dr. Hayes the reindeer is still very abundant in the interior of the land, but the Green-

FIG. 2.—1. Fur glove with bear claws. 2. Bone knife for cleaning boats. 3. Drinking-spoon. 4. Bone table-spoon. 5. Bone boxes with bundles of thread made of birds' entrails. 6. Bone hook with iron points

landers do not make use of it either as food or as a means of locomotion. Birds are very abundant; their plumage is used as fur, and their sinews as thread.

But the domestic animal is the dog, which they yoke to sledges by means of a small harness of sealskin. The nine dogs which the Eskimo have brought to Paris, and

harness to their sledge, are very large. Their white hair spotted with black and red, is long and abundant; their ears are erect, head large, their iris of the colour of *café au lait*.

Let us, however, examine the more immediate environment of the Eskimo—their house. It is composed of a hillock of turfed earth, of square form, recalling somewhat our military fortifications. It is entered by a low door giving access to a narrow and very low passage, in which the Greenlander himself, notwithstanding his small size, is forced to bend down. The single apartment to which this passage gives access, and the floor of which is lower than the surrounding ground, is ventilated by an orifice in the upper part. It is lighted by two openings on each side of the door, and hermetically closed by strips sewn together of a sort of goldbeater's skin made of the intestines of the seal. This kind of immovable glazing sifts into the apartment a sufficient light, but appears from without altogether opaque. The furniture consists of a sort of camp-bed which occupies the entire half of the apartment, provided with sealskins, and on which the whole family pass the night, after having taken off their day costume, and put on another more ample dress. On the ground a stone basin, said to be of serpentine, the form of which resembles that of a fish, is filled with seal oil, in which are steeped several wicks. The flame which rises from this vessel

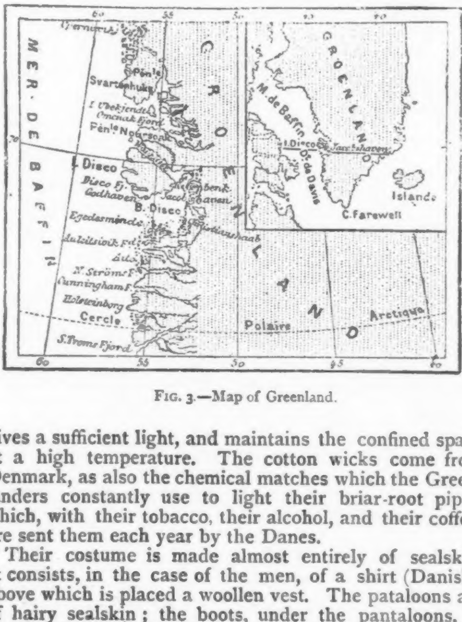


FIG. 3.—Map of Greenland.

gives a sufficient light, and maintains the confined space at a high temperature. The cotton wicks come from Denmark, as also the chemical matches which the Greenlanders constantly use to light their briar-root pipes, which, with their tobacco, their alcohol, and their coffee, are sent them each year by the Danes.

Their costume is made almost entirely of sealskin. It consists, in the case of the men, of a shirt (Danish), above which is placed a woollen vest. The pataloons are of hairy sealskin; the boots, under the pantaloons, of sealskin leather. Gloves of fur, armed, when necessary, with bear's claws, blue spectacles—against the wind and the reflection from the snow—complete the accoutrement. The costume of the women is not wanting in elegance. The hair is raised *à la Chinoise* on the top of the head, and bound into a sort of vertical chignon, tied by a coloured knot. A well-fitting blouse of European material trimmed with fur, is provided with a hood, in which the mother carries, when necessary, her latest born, as the opossum does her young. The woman wears very tight breeches of sealskin and high boots reaching above the knees; red, embroidered with yellow, after marriage; white, embroidered with green, among unmarried girls.

Their arms consist of bows with which they shoot arrows pointed with bone or iron, and similarly made harpoons, which they throw from the hand. When the harpoon is to be thrown into the water it is attached to a cord provided at the other end with an inflated seal-bladder which acts as a buoy and prevents the loss of the wounded animal, which would run away into deep water with the harpoon. Their other apparatus are iron fish-hooks, wooden baits representing fish, coloured, and very well imitated. To these we may add cases of skin which they put on the paws of the dogs when the cold is very intense; leathern muzzles to put over the snout of the dogs, smoothing-irons of *stone*, knives identical with those which iron-tanners use to dress skins, and intended for the same purpose. This will give an idea of all that the Greenlanders have to help them to struggle against the inclemency of their native climate.

But an element not less important than the house in the idea of an Eskimo is the boat. The boats, all of seal-skin well stretched over a framework of wood or bone, are furnished with tackle of leather. They are of two kinds; every man possesses a small boat, the *Kayak*, a boat decked all over, except in the middle, where it is pierced with a circular opening, into which the fisher insinuates and fits himself, the legs extended under the deck, and where he remains hermetically enveloped around the loins by what looks like the upper part of a leathern bag fixed to the edge of the hole and attached round the waist. Thus united to his boat, the Eskimo manœuvering his double-bladed paddle produces an impression analogous to that which gave origin to the legend of the Centaurs. A large sealskin bottle placed behind the fisher—a sort of swimming-bladder—increases the specific lightness, and renders the whole unsinkable. The other boat, very much larger—the *Umyak*—is used only by the women, who manage it with the children and furniture.

Before concluding what relates to the surroundings, one word about the alimentation. The word *Eskimo* is not the name which they give to themselves. They call themselves *Innuit* (the men); so true is it that under all climates human vanity prevails (*Los Ombres: Innuit*). The name *Eskimo* (eater of raw fish) is a malevolent nickname given them by their American neighbours. It is not, however, so well merited now as it was last century, at the time when Crantz observed them. They continue, nevertheless, to eat raw the lard sent them from Denmark and also the lines of the seal. The rest is eaten cooked. This custom of eating raw lard gives rise to the frequency of tapeworm in Greenland.

What has been said of their voracity still appears not to have been exaggerated. Like all peoples whose *pabulum vitæ* is uncertain, they go two or three days, especially during winter, without food, but on the first favourable occasion they exhibit a gluttony which is not always a compensation.

Phthisis is extremely frequent; it produces about three-fourths of the total mortality, and is almost always characterised by blood-spitting.

If we seek for what relates to intellectual phenomena, we find little artistic sentiment, but great accuracy, and an easy submission to what has come to them from Europe. Converted to Protestantism by the Moravian Brothers, they read in the Jardin d'Acclimatation a Greenlandish translation of the Bible, which appears sufficient to satisfy their literary aspirations. They sing slowly psalms which their ministers have taught them. Their writing, in Roman characters, is neat, correct, and precise; it has something of the slowness of their movements.

An extreme precocity of development seems to characterise them. Thus, the young Catharine Okabak, who was born on October 20, 1876, possessed, on October 20, 1877, four canine teeth, eight incisors, four premolars, in all sixteen teeth. She ran alone and commenced to speak at the age of ten months. Her sister Anna, who

is twenty-five months old, has twenty teeth. It is true that this precocity corresponds, as is often the case, to a feeble longevity. The *metis* of forty-one years appears already old, and it is generally acknowledged that in Greenland a man of fifty-five, or a woman of sixty years, is an exception. Young girls are quite formed at from fourteen to fifteen years; suckling continues for four or five years.

Their height is small; their black hair is straight; the face broad and flat; the head is dolichocephalic; the cheeks are large, plump, and round; the lips are thick, the lower pendent; the eyes are small, dark, oblique, like those of the Chinese, and connected by a fold of skin at the level of the internal angle. The teeth are large, yellow, but sound; the canines a little projecting. The beard is feebly developed, as is indeed the hair in other parts of the body; the skin is brown and even black among the aged. The following figures give a more precise idea of these peculiarities:—

Their mean height is 1·46 metres, a figure higher than that which is given by Hearn to the Eskimo (1·299 m. for the men and 1·271 m. for the women), but inferior to that of MM. Bellebor and Guerault (1·50 m.); a figure which places them in the category of small-sized men, *i.e.*, under 1·60 m., and between the Veddas (1·535 according to Bailey) and the Negritos (1·478 m.), after whom we find only the Bushmen.

The cephalic index places these Eskimo among the dolichocephalic, one only, the woman, among the sub-dolichocephalic. Their mean index is 73·51 (maximum 76·88, and minimum 70·95). The mean index of Bessels was more dolichocephalic still; it was 71·37. It should not be forgotten, however, that the figure varies with the locality of the Eskimo. The Eastern Greenlanders of Davis gave a cephalic index of 71, the Western, 72; those of Virchow, 71·8; those of Pansh, 72.

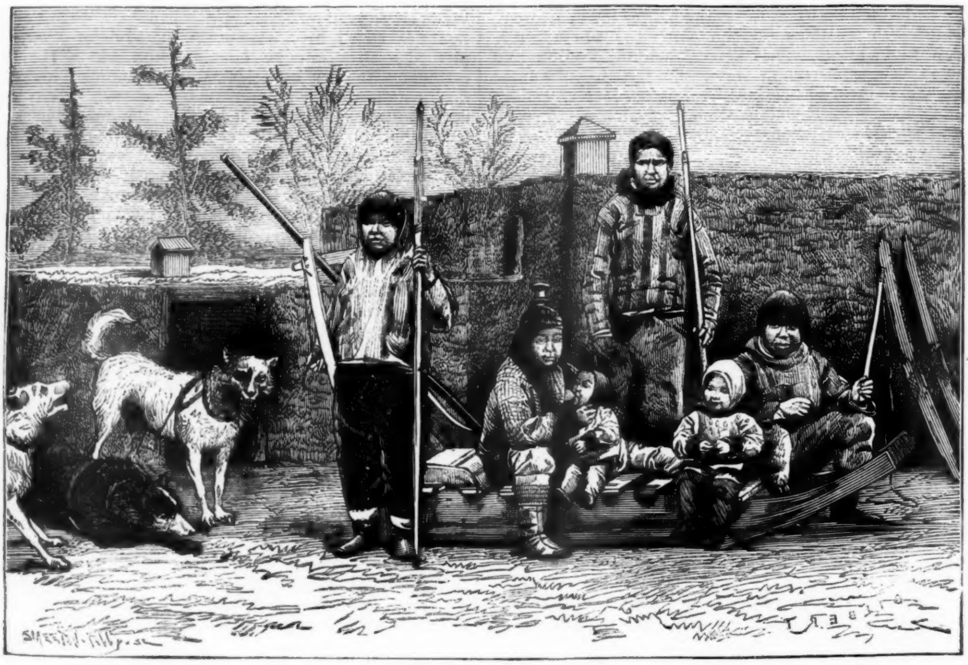


FIG. 4.—The Eskimo in the Jardin d'Acclimatation.

It is necessary to compare the anterior or intellectual part of the cranium with the posterior part. The results deserve to be given one by one. In Okabak, the total horizontal curve of the cranium being supposed equal to 100, the anterior curve will be represented by 45·2; in Kojanki by 48·5; in the woman by 48·1; lastly in the half breed by 44·7; I do not speak of the children. It is worthy of remark that this numerical classification corresponds exactly with that which each of us had made in estimating the intelligence of each of these subjects. Kojanki and Mrs. Okabak were judged superior to the two others. The mean of the anterior cranium is 46·6, which places the Eskimo in what Gratiolet designates the occipital races—those among whom the posterior cranium outweighs the anterior cranium. The mean facial angle is 66·7°. The height of the nose being supposed equal to 100, the mean breadth will be 70·5, while among the Cochin-Chinese it is 89, and among the negroes 110, 112, and even 115. One index gives very well the measure of the small prominence or flatness of the nose; this is the antero-posterior nasal index. Among our Eskimo, the breadth of the nose at its base being supposed equal to 100, the mean prominence of that base in front will be 55·5, while the same mean index among Europeans is 66·6.

Such are the principal facts I have been able to collect in reference to the Eskimo of Jacobshavn, now in Paris; they may be defective, because based on a very small number of subjects; nevertheless, it is to be wished that the director of the Jardin d'Acclimatation will continue the experiment so well begun, and that besides the Nubians and Eskimo he will introduce other representatives of races so interesting and so little known, whom civilisation will, so far as science is concerned, cause to disappear sooner or later.

A. BORDIER

POZZOLANA MORTAR AND PINE TIMBER

THE following letter has been sent us for publication by Prof. Tyndall:—

Villa Guastalla, Via Palestro, Rome, April 14

SIR,—A very curious and unexpected circumstance has occurred in Rome, which, as it depends on chemical action, may have some interest for you.

Prior to 1870, when Rome became an integral part of the kingdom of Italy, the beams used in the construction of houses were of chestnut wood. After that date a vast amount of building was undertaken and now a whole quarter of the city stands on ground formerly occupied by vineyards and gardens.

In lieu of chestnut, pine was largely used, having been brought *viâ* Venice from the Dolomite Alps. The latter was preferable, as being procurable of larger scantling, of greater length and at a less cost.

After a few years, the roofs and floors in which the pine had been used were found to be failing. A beam used in a flat roof or in flooring, where it was imbedded in a wall was found to be rotten; while the body of the beam was perfectly sound. A very considerable sum of money was thus lost, as many of the roofs and floors of the new houses on the Esquiline had to be renewed.

But what was the cause of this sudden perishing of the ends of the pine beams, such as had been known to last centuries in Venice? The answer to this question remained a puzzle for a long time; until on taking down the scaffolding of the Ministry of Finance lately completed, a complete answer was found.

One of its scaffold poles had been imbedded for, say, four feet in the ground; about its foot was a heap of the *débris* of Pozzolana mortar, say, six feet high. That part which had been underground was perfectly sound; that which had been surrounded by mortar was utterly rotten; and finally, the remainder of the pole above the ground was perfectly sound. Hence, it was clear that the mortar was to blame. But in what respect did this mortar differ from that used at Venice in which pine wood beams lay embedded for centuries with impunity? The sole difference was in the use of pozzolana—a volcanic earth—instead of sand, and as this substance had been used for mortar in Rome and Naples for ages in contact with chestnut beams with impunity, the only logical conclusion is that pozzolana and pine wood have some chemical affinity which causes some of their ingredients to combine, to the destruction of the latter.

Inclosed are a few grains of pozzolana, such as is used for mortar in Rome.

Yours faithfully,

HENRY H. MAXWELL, Lieut.-General R.A.

Dr. Tyndall

STANFORD'S STEREOGRAPHICAL MAP OF THE BRITISH ISLES

MR. STANFORD has recently issued a map which marks a distinct advance in British cartography, and one which gives us ground for hoping that some day we may be able to equal in this country the work of the geographical establishments of Germany. The map in question represents, in the first place, the United Kingdom, with its hills and mountains standing solidly out from the ground, as if a perfect relief model of the country lit up from the North had been photographed. The plains and valleys are also clearly shown; on ordinary maps these cannot be distinguished, and yet they are as important features as the hills themselves.

Great care has been taken to embody all the usual information without in any way detracting from the beauty of the map. Thus the railways are shown, and cities and towns, so as not to interfere with the physical features, as well as the hills and plains, vales and rivers, are named in a clear yet delicate type.

As an example of the information conveyed, we can mark in the map how the ground rises gradually in going west from London all the way to the summit ridge of the Chiltern Hills, and then falls suddenly to the Vale of Aylesbury and the Vale of the White Horse; the ground again rising gradually to the summit of the Cotswold Hills, and then falling suddenly to the valley of the Severn; how the headwaters of the Thames all lie on the top of the second ridge, while the first ridge is the boundary between the Upper and Lower Thames Valley, presenting only one vulnerable point, between Walsingham and Reading, through which the river can make its way.

Mr. Stanford claims that the map is at the same time artistic and scientifically accurate; and from the examination we have made we believe both claims can be well made out.

OUR ASTRONOMICAL COLUMN

TRANSITS OF MERCURY.—After the transit of Mercury across the sun's disc on Monday next, May 6, which will be visible in this country through about half its duration, there remains only one transit of this planet at the descending node in the present century; it will take place on May 10, 1891, with the following elements according to Leverrier's tables of sun and planet:—

G.M.T. of conjunction in R.A. 1891, May 9, at 15h. 55m. 40s.

		$^\circ$	$'$	$''$
R.A.		46	44	14·1
Sun's hourly motion in R.A.			2	26·2
Planet's ,, ,, ...	−		1	18·7
Sun's declination	+	17	32	1·9
Planet's ,, ...	+	17	18	0·4
Sun's hourly motion in decl.	+		0	39·6
Planet's ,, ,, ...	−		1	6·7
Sun's horizontal parallax				8·76
Planet's ,, ,, ...				15·92
Sun's semi-diameter			15	50·33
Planet's ,, ...				6·01

Whence the first external geocentric contact occurs at 11h. 53m. 19s. at 65° from the sun's north point towards the west, for the inverted image, and the last external contact at 16h. 52m. 18s. at 12° from the north point towards the east. At Greenwich the external contact at ingress takes place at 4h. 50m. 26s. A.M. on May 10, and the sun's centre is in the horizon at 4h. 18·5m., so that Mercury will be only half an hour upon his disc, after observation is possible here. And while the egress of the planet from the solar disc is alone visible in these islands in the transit of 1891, in that of November 10, 1894, at the opposite node—the last phenomenon of the kind in the nineteenth century—the ingress only can be witnessed here, under favourable atmospheric circumstances, not to be insured at this season; the first external contact at Greenwich taking place at 3h. 55m. P.M. and the sun setting at 4h. 18m.

At the sitting of the Paris Academy of Sciences on April 22, a letter from M. André was read, stating that the expedition sent by the Academy and the French Minister of Public Instruction, to Ogden in the Utah territory for the Observation of the Transit of Mercury in the present month, had arrived safely at its destination. After experiencing very liberal treatment from the French Trans-Atlantic Company, the instruments were admitted without payment of duty at New York, and the observers received free passes on the lines of railway converging in Utah, both for the outward and homeward journeys. The Government of Washington placed at their disposal the nearly-finished observatory at Ogden, at the same time undertaking to provide gratuitously all necessary appliances for the observations. A telegraphic wire from Washington to Utah was available

for determination of time, and the authorities of the U. S. Naval Observatory confided to the expedition the photographic instruments which had been employed by the American parties on the occasion of the late Transit of Venus, for comparison with those brought from France. M. Sainte-Claire Deville in communicating these particulars to the Paris Academy, adds—"Il suffit de publier tous ces détails pour que la gratitude de tous les savants soit acquise à de pareils actes de confraternité scientifique."

KEPLER'S MANUSCRIPTS AND RELICS.—In the last Annual Report of the Director of the Imperial Observatory at Pulkowa, M. Otto Struve, to the Visiting Committee, attention is called to an interesting acquisition recently made by this great astronomical establishment. It is known that the library possesses in addition to all the notable published works of Kepler, the nearly complete collection of his manuscripts. This circumstance caused Prof. Galle, of the Observatory at Breslau, to inform M. Struve that certain articles of which the last direct descendants of Kepler, resident in Silesia, were in possession, and which had been religiously preserved in the family as memorials of their immortal ancestor, might be obtained by purchase, and the result has been that they are now deposited at Pulkowa, to be preserved with other astronomical treasures, which the Struves, father and son, have secured for the institution. Amongst these articles are particularly mentioned two miniature portraits on copper of Kepler and his first wife, at the time of their marriage, and a memorandum-book used by his first wife and continued by his eldest daughter.

THE PULKOWA LIBRARY CATALOGUE.—In the same Report from the Director of the Russian Observatory, it is mentioned that a continuation of the Catalogue of the valuable library has been some time in preparation, the numerous additions, upwards of 10,000, which have been made to it since the publication of the first Catalogue in 1860, rendering a more complete work very desirable. M. Otto Struve justly remarks that the Catalogue of 1860 has had its uses beyond the pale of the establishment, and we feel sure that workers in almost every branch of astronomy will bear witness to the assistance they have received from that excellent and well-arranged analysis of the contents of this important library, whereby they will have been guided with comparative facility to a knowledge of the literature special to particular astronomical subjects upon which they have been engaged.

GEOGRAPHICAL NOTES

ROUND THE WORLD.—The French Société des Voyages Autour du Monde, have obtained the steamer *Picardie*, of the company Valery frère et fils, of Marseilles, in which to make their intended voyage round the world. The vessel is 1,560 tons and 1,000 horse-power, and is fitted up in the best manner. She is announced to leave Marseilles on June 30 under the command of Lieut. M. G. Biard. The staff is complete, and it is stated that the passenger list will shortly be closed. This project seems likely to have a better result than the much-talked-of American Woodruff Continental Voyage Round the World, which from the first seems to have been utterly hollow, and collapsed on being probed.

AFRICA.—In his recent journey in East Central Africa, the late Capt. Elton, H.M.'s Consul at Mozambique, paid considerable attention to the northern end of Lake Nyassa, which was previously very imperfectly known. He arrived, we believe, at a very positive conclusion that no river flowed out of the lake, but he discovered an important and navigable affluent, the Rombashi River. This he considered to be well suited for the line end of the caravan road from the coast. This road, which is being constructed by private enterprise and under the supervision of English engineers, starts from Dar-es-Salam, some twenty miles to the south of Zanzibar, and thirty or forty miles of it have already been completed. When finished it will, no doubt, have an important bearing on the future of this part of Africa, and it will open up to commerce and civilisation a region a considerable portion of which has remained hitherto entirely unexplored.

The Abbé Debaize, who recently received a subvention of 100,000 francs from the French Government for purposes of African exploration, left Marseilles on April 20 for Zanzibar, where he will arrive at the end of May. He will remain there for some time in order to make the most complete preparations for his journey across the Continent, which is expected to occupy three years. The same steamer carried nine French missionaries despatched to establish posts at the Victoria Nyanza and Lake Tanganyika.

NOTES

PROF. HUGHES, the well-known inventor of the type-printing apparatus so largely employed on the Continent, has made the wonderful discovery that some bodies are sensitive to sound as selenium is sensitive to light. If such a body be placed in the circuit of a small battery it will be so affected by the sonorous vibrations when spoken to as to replace entirely the transmitter of a Bell telephone. Conversation, music, and all the sounds transmitted by an ordinary telephone are easily reproduced. A mere scratch with the finger-nail, or a touch with the soft part of a feather is distinctly transmitted. The sonorous vibrations produce strains in the conductor, which cause variations in the resistance of the circuit, and thereby produce similar variations in a current flowing through that conductor.

THE French deserve all the praise that has been recently lavished upon them for the energy and determination and sound judgment with which they have quietly carried on the preparations tht culminated in the imposing ceremony of yesterday. Their new Exhibition is the one bright spot in the European horizon at present. Even till very recently many doubted whether these preparations would ever come to anything, partly on account of the disturbed state of Europe, and partly because the earnestness and perseverance of the French as a people were doubted. We have had frequent occasion recently to bring before our readers evidences of the renewed energy of the French in respect of scientific research; and the unprecedentedly magnificent display which now divides the attention of the world with the Eastern crisis, is only one of many other proofs that the French are rapidly achieving for themselves a position more solid than ever they held before. The world, then, is once more taking stock of her industrial riches, and ever since the Exhibitions of Vienna and Philadelphia, the discoveries and applications of science have been so many and so rapid that the Paris Exhibition must present many new features. For, indeed, however much the great mass of visitors may ignore it, the multitudinous display that was opened yesterday, is simply a specimen of the gifts of science to humanity, as the French themselves would say. Judging from the catalogues British trade is well represented, and our principal scientific-instrument makers are well to the front; but British culture and British science are nowhere, and, as we have said already, the British Commissioners have lost a splendid opportunity, and will have simply nothing to show beside the magnificent educational and scientific collections of France herself. We have already spoken at length of the many preparations made for representation of French science—scientific conferences, the scientific lectures, scientific excursions, besides the great display of

scientific exhibits; the British Department will be nothing more than a trade show. Let us hope that the British Commissioners and British visitors generally will return from Paris ashamed of their shoppy display, and filled with a sense of the vast national importance of science, which in the case of France, it will be seen, truly "exalteth a nation."

THE large fresh-water and salt-water aquariums in the Trocadero Gardens at the Paris Exhibition were stocked last week. A regular service of barges is engaged in bringing daily quantities of sea-water from the coast to supply the second aquarium.

THE amount proposed to be spent upon the building of the new Natural History Museum at South Kensington for the present financial year (1878–79) is, according to the Civil Service Estimates, 80,000*l.*, being 10,000*l.* more than last year. Of this sum, 60,000*l.* is for the building, which is now verging towards completion, and 20,000*l.* for internal fittings. We are pleased to see that the authorities are already turning their attention to the last subject, but should they not also begin to think about a *library?* As regards scientific work, the natural history collections in their new house will be absolutely *useless* without a library. Our readers may possibly think that a scientific library may be got any year by the use of a certain quantity of money, but they will find themselves very much disappointed when they attempt to try this experiment. The fact is, such a library as is required for the use of a great national museum can only be picked up by slow degrees, and so soon as it was determined to move the collections away from the great public library in Great Russell Street, steps should have been taken to form a new one for the collections in their new site. This, however, does not appear to have been thought of yet.

OUR readers will be glad to hear that Prof. Clifford, who is at present at Gibraltar, is somewhat better.

THERE was a *conversazione* at the Royal Society last evening.

THE Vice-Chancellor of Cambridge University has appointed Prof. Clerk Maxwell Rede Lecturer for the ensuing year.

AN agreeable variation on the daily news from Constantinople is the report of the completion of the Museum of Antiquities in the Turkish capital. In 1875 Arifi Pacha, the Minister of Instruction, ordered the renovation for this purpose of an old kiosk on the Seraglio Point, built in 1471 by the conqueror of Constantinople, and the work has been pushed steadily forward, even despite the war, until now a spacious edifice, richly decorated with marble, is ready to receive the archæological collection of the city. Visitors at Constantinople who have found their way to the dark, dusty hall in the arsenal, where quantities of valuable antiquities were crowded together in chaotic confusion, will appreciate the value of this ample provision for their exhibition, especially for the extensive collections resulting from Schliemann's excavations at Troy. A school of archæology is to be established in connection with the museum.

WE have variety enough of Associations, learned and otherwise, in this country, but none corresponding to that which met on April 24 and subsequent days at the Sorbonne, composed of the delegates of the various learned societies throughout France, and founded by Leverrier many years ago. We have the elements for such an association in abundance; and, indeed, concretions of greater or less extent have begun to form in different parts of the country. There is, for example, the Cumberland Association, which met last week, and which, if not founded by our national astronomer, like the French Association, had the honour of listening to what he describes as probably his last public lecture. Then there is that extensive association of societies and field-clubs in Yorkshire, which publishes a journal of its own; and most recent of all, there is the Midland Union, with head-quarters at Birmingham, extensive ramifications, and "running" an excellent magazine, the *Midland Naturalist.* But there is room for something more national and more universal than any of these, and not interfering with their action at all; and as a preliminary step we would suggest that a general meeting of delegates from the various local societies throughout the kingdom should be held at some central city. Such a meeting might be useful in many ways, leading as it might do to united action with regard to common interests, as useful, indeed, in respect to our local societies, as the recent Conference of Librarians has been to the libraries of the world. If properly organised we believe the meeting would become an annual institution.

THE President of this year's meeting, the sixteenth, of the French Learned Societies, was M. Milne-Edwards, who devoted his opening address mainly to the memory of the Association's founder, Leverrier. The number of delegates was smaller than in former years, many of them having postponed their visit to Paris till the Exhibition was opened, and the discussions seem to have lacked the keenness and impressiveness which always characterised them when Leverrier presided. The first two days were devoted to sectional meetings, and on the concluding day the distribution of prizes took place, as usual under the chairmanship of the Minister of Public Instruction. An immense crowd had been attracted in the hope of hearing from M. Bardoux himself what was the intention of the Government with regard to education; but he postponed any definite statement to the month of October, when the association will hold a supplementary meeting after having taken part in the several scientific congresses and lectures held at the Trocadero. He reviewed all the improvements realised last year in the educational system of France. "Soon," he said, "everywhere when the want will become manifest, libraries, laboratories, and collections will be established exhibiting the passionate zeal of Government for everything which touches the superior interest of instruction. A time will soon arrive when every hamlet will have its own school and when the tools of intellectual work will be at the disposal of every seeker." There can be no doubt of the sympathy of the present French Government for every form of scientific effort. Some important scientific papers were read during the meeting, but we cannot at present do more than mention the fact. In the scientific section gold medals were assigned to M. Cailletet for the liquefaction of gases, Dr. Armand for explorations in Cambodia and Laos, General de Nansouty, founder of the Observatory on Pic du Midi; Prof. Terquem for physical researches, and Prof. Houel for mathematical works.

ALTHOUGH no allusion was made by M. Bardoux in his address at the Sorbonne to the contemplated improvements meditated for French meteorology, we can state that he will ask from the French Parliament a credit of 10,000*l.*, and 2,000*l.* for five successive years, in order to organise in France ten large meteorological observatories, possessing each a complete set of registering instruments. The contemplated institutions, some of which have been already created, will be located at Lille, Paris (Montsouris), where M. Marie Davy will be continued superintendent, at the country seat of Mr. Hervé-Mangon in the department of La Manche, where a private observatory has already been organised, at Bordeaux, Toulouse, Marseilles, Lyons, Besançon, and the three elevated observatories, Pic-du-Midi, Puy-de-Dôme, and Mont Ventoux.

THE Annual Meeting of the Cumberland Association for the Advancement of Literature and Science may now be regarded

as an established institution. The gathering at Cockermouth on Monday and Tuesday last week was large and successful. The event of the meeting was no doubt Sir George Airy's Address, which we hope to give next week, but there were other addresses and papers read which would do credit to more pretentious associations. The president, Mr. Isaac Fletcher, M.P., F.R.S., in his address, gave an interesting sketch of George Graham, the eminent horologist of the eighteenth century, who was a Cumberland man. Mr. Clifton Ward, to whom the success of this Association is largely due, read a valuable paper on Quartz in the Lake District. The telephone of course was exhibited, and several interesting excursions made; and last, not least, the Report tells us that the Association and its affiliated Societies are prosperous. Why should not each county or group of counties, have a similar association? The Midland Union of Natural History Societies, numbering over 2,000 members, are to have their meeting at Birmingham on May 27 and 28; and judging from the brief programme it promises to be an interesting one. With independent sources of many-sided and vigorous activity in the country like Birmingham, there is no danger of over-centralisation.

AN alarming paragraph recently appeared in the Swiss correspondence of a German paper, which, affecting as it does the existence of the St. Gothard tunnel, we are surprised that it has not been even referred to in English journals. The paragraph stated that the great engineering undertaking of boring through the St. Gothard was threatened by the possibility of a severe check in a direction hitherto unexpected. "The geologists engaged in the work," it was stated, "have lately noticed a peculiar depression of the strata through which the tunnel is progressing, leading to the suspicion that a subterranean sea occupies the interior of the mountain chain at this point. The last report laid before the Swiss Federal Council, states that these indications are becoming more and more decided, and it is expected that the next 700 feet of boring will yield decisive proofs for or against this theory. If the fears prove true, the whole of the work on this magnificent undertaking, will come to an abrupt and unfortunate conclusion." These sentences partake of the usual character of what may be called "newspaper science." They contain just enough of scientific phraseology to impress the ordinary reading public with the importance of their announcement; while at the same time their statements are so vague as to afford the reader who knows something of the subject no means of deciding whether the thing is a hoax or may have some kind of foundation in fact. Happily the apparently insuperable difficulty has been boldly faced with the usual results. A recent report of the inspector of the tunnel states that the irregular character of the formations pierced by the tunnel, which led to the above fears, has entirely ceased, and that the work is now progressing through uniform regular strata. On the south side the boring progresses at the rate of ten feet daily through gneiss. The rate is somewhat less on the north side, where the tunnel is not yet out of the serpentine. The thickness of this stratum of serpentine now being pierced is already the double of that estimated by geologists from the surface indications.

THE forty-ninth anniversary meeting of the Zoological Society was held on Monday. The report of the Council stated that the number of fellows, fellows-elect, and annual subscribers, at the close of the year 1877 had amounted to 3,358, showing a net addition to the list of 47 members during the year 1877. The income of the Society in 1877 had amounted to 30,988*l.*, being, with the exception of 1876, a larger total than the receipts of any previous year since the foundation of the Society. The total ordinary expenditure of the Society in 1877 had been 27,290*l.*, the remaining sum of 1,711*l.* having been devoted to certain special objects, such as new buildings. The Society has purchased the freehold of the present house (11, Hanover Square), and of the house immediately adjoining it at the back (314½, Oxford Street). The total assets of the Society on December 31, 1877, had been calculated to be 17,989*l.*, while the liabilities were reckoned at 4,019*l.* The total number of visitors to the Society's gardens during the year 1877 had been, according to the report, 781,377, a number greater than had been recorded in any previous year except in 1876. With regard to the state of the menagerie, it was stated that the total number of animals belonging to the first three classes of vertebrates living in the Society's menagerie at the close of 1877 had been 2,200. The total number of registered additions to the menagerie in 1877 had been 1,260. The Marquis of Tweeddale, F.R.S., was re-elected president; Mr. Robert Drummond, treasurer; and Mr. Philip L. Sclater, Ph.D., F.R.S., secretary to the Society for the ensuing year. The new members of the Council elected were—Sir Joseph Fayrer, K.C.S.I., F.R.S., Lieut.-Col. Godwin-Austen, Dr. Günther, F.R.S., Dr. Edward Hamilton, and Prof. Huxley, F.R.S.

DR. F. V. HAYDEN sends us a first proof of a plate to appear in one of the volumes of the Bulletin of the U.S. Geological Survey, in which is represented the greater part of a fossil skeleton of a very remarkable new bird about to be described by Mr. Allen under the name *Palæospiza bella*.

THOUGH we have not heard of or from Mr. Benson for some time, he has not been idle. Two papers by him are now before us. In one of these ("Facts and Figures for Mathematicians; or, the Geometrical Problems which Benson's Geometry Alone can Solve") the problem is, "given the area of a circle, say of one acre, to find that of another circle, which being described from a point as centre, on the circumference of the given circle, shall have that portion of its area outside the given circle equal to the area of the given circle." A similar problem to this vexed us in our undergraduate days. We were required to find by purely geometrical means (if possible) the length of a chain which, fastened to a stake in the boundary of a circular field, would allow an ass to graze over just half the field. Mr. Benson says the solution depends upon the *actual*, not the supposititious properties of the circle, and therefore the result as given in the *Scientific American* (where the ratio of 1 to 1·158728 is stated to be the one required) "which is based upon the false supposition that the circle has similar properties to those of the polygon" is erroneous. It may be remembered that Mr. Benson will have it that the value $3{\cdot}1415926 \times R^2$ for the area of a circle is wrong. As we stated in our notice of the "Geometry," our author maintains that the reasoning mathematicians employ to get this result is fallacious, and in his opinion he makes this easily evident. He still holds that $3R^2$ is the area.

"A man convinced against his will
Is of the same opinion still."

Mr. Benson argues *more suo* in the twenty-two pages which he devotes to the problem. The second publication ("New Mathematical Discoveries") is a four-page one, and is concerned with the discovery of Archimedes that the proportion between the parabola and the rectangle on abscissa and ordinate is in the proportion of 2 : 3. From the proof employed to show this, he comes round to the circle again, and gets area $= 3R^2$. To judge by the printed letters, Mr. Benson has adherents to his views; among them one a graduate of the Polytechnic School in Paris, writes that "they (these discoveries) will revolutionise the mathematical world," and he is translating them for publication in France. Mr. Benson (whose motto should be "indefessus agendo") is engaged upon "Philosophic Thoughts in all Ages" and "Geometer's Manual," containing history of geometry and correspondence

with prominent English and American mathematicians on new geometrical subjects. Our author has a mission; if any hold with him, they should write to L. S. Benson, 149, Grand Street, New York City, and become the happy possessors of a copy of "Facts" for thirty cents. *De gustibus non disputandum.*

THE *North China Herald* reports a curious desire for improvement on the part of two Corean medical men, who belong to a nation which has hitherto shown itself the most determined in its self-isolation. These men have applied to Dr. Dudgeon, the Superintendent of the London Mission Hospital, for permission to attend there during the stay of the Corean embassy at Peking. They are described as very intelligent men, and they speak very disparagingly of their own medicine. For years they have been studying Hobson's medical works in Chinese, and they have also obtained Dr. Dudgeon's Anatomical Atlas. They are greatly interested in vaccination, and wish to introduce it into Corea. The stringency of Corean laws prevents natives from living out of their own country, but the next time the embassy visits Peking these two men intend to devote more time to the study of foreign medicine and surgery.

ALTHOUGH the existence of kerosene oil in several of the provinces of Japan is said to have been known for 1,200 years, the Japanese did not know how to refine it till about six years ago. Now, however, refining establishments are springing up rapidly, and its manufacture is becoming an important industry.

AT Dresden a new journal appeared on May 1 entitled *Zeitschrift für Museologie und verwandte Wissenschaften;* the editor is the Director of the celebrated "Grüne Gewölbe," Hofrath Dr. Grässe, the publisher, Herr T. M. Hofmann. Thus the circle of "collection-journals," *i.e.* journals for archives, libraries, and museums, is complete.

A GERMAN inventor has found a new use for asbestos, in the shape of leaves for a bank-note-album. These albums are said to protect bank-notes or other valuable documents to such an extent, that if they are laid between the leaves and the album is closed firmly, they even remain legible after being burnt to cinders.

MR. F. C. PENROSE writes to the *Times* from Copse Hill, Wimbledon, that on April 24, at 8.12 P.M., he saw an unusually fine meteor descending at a very steep angle, and when first noticed, at about 2° to the north of the bright star Procyon, and sloping a little to the north. It was yellowish, and although not in itself intensely bright, from its apparent size (5′ long and 3′ broad by estimation), surpassed the light of Venus at her maximum. It was as usual pear-shaped. After a course of about 10° from the point first mentioned, it left behind it three or four very bright blue star-like points, and vanished in a clear sky at about an altitude of 22° and 57° west of south. No sound of explosion was heard.

A PERUVIAN chemist, Dr. Arosemano, will exhibit an invention at the Paris Exhibition, which may become a very important one for commerce. He has succeeded in obtaining a magnificent dye from the violet or maroon Welshcorn of Peru, and this dye is said to impart the colour, odour, and taste of claret to all light white wines to such a degree, that it is impossible to distinguish the coloured wine from real claret, without being in the least injurious to the health of the consumer. Besides this a number of other uses are mentioned to which this Welsh corn-dye can be put.

THE German Telegraph Office is rapidly introducing the telephone; 68 stations are already provided with this instrument, 41 others will have it in a few weeks, and 111 more before the end of the year; thus there will be then a total of 220 telephone-stations in Germany.

TO commemorate the 100th anniversary of the discovery of the Sandwich Islands by Cook, a statue of the great discoverer will be erected on Diamond Peak, a burnt-out crater near Honolulu.

SEVEN extremely interesting pictures are now being exhibited at Berlin by the painter, Herr J. L. Wensel; they represent scenes from the second German North Polar Expedition during the years 1869 and 1870, and are executed after sketches made on the spot by several members on the staff of the expedition.

THE Conference on the National Water Supply, in connection with the Society of Arts, will meet on the 21st and 22nd inst., and will be followed on the 23rd and 24th by a Conference on the Health and Sewage of Towns.

THE additions to the Zoological Society's Gardens during the past week include a Beisa Antelope (*Oryx beisa*) from North-East Africa, presented by H.H. the Sultan of Zanzibar; an African Leopard (*Felis pardus*) from Africa, presented by Mrs. Kirk; a Black Wallaby (*Halmaturus ualabatus*), a Laughing Kingfisher (*Dacelo gigantea*) from Australia, presented by Mr. D. W. Barker, jun.; a Sand Lizard (*Lacerta agilis*), a Smooth Newt (*Triton tæniatus*), European, presented by the Masters W. L. and B. L. Sclater; a Common Seal (*Phoca vitulina*) from British seas, a Cariama (*Cariama cristata*) from Brazil; a Guira Cuckoo (*Guira piririgua*) from Para, a Crested Curassow (*Crax alector*) from Guiana, a Bar-headed Goose (*Anser indicus*) from India, a White-faced Tree Duck (*Dendrocygna viduata*) from Brazil, a Red-billed Tree Duck (*Dendrocygna autumnalis*) from America, a Blue-bonnet Parrakeet (*Psephotus hæmatogaster*) from Australia, purchased; a Bennett's Wallaby (*Halmaturus bennetti*), born in the Gardens.

THE UNIVERSITY OF OXFORD COMMISSION

THE Vice-Chancellor has received from the University of Oxford Commissioners a Statement with respect to the main purposes relative to the University, for which, in their opinion, provision should be made under the Act, the sources from which funds for those purposes should be obtained, and the principles on which payments from the colleges should be contributed. The statement is somewhat similar to that published in reference to Cambridge some weeks since, only more detailed.

As to the main purposes relative to the University for which provision should be made under the Act, the first in order of these purposes is, in their opinion, the extension and proper endowment of the professoriate, and the better organisation of University teaching. As to which two principal objects should be kept in view:—1. The due representation at Oxford of every considerable branch of knowledge, the advancement of which can be effectually promoted by the University, as a place either of education or of learning and research; and 2. The due participation of the University itself, as distinct from its colleges in the direction and improvement of the studies of its undergraduate and other students.

The Commissioners are unable to adopt the views of those who would desire to transfer to the University the whole or the chief part of the teaching work now done by the colleges either separately or by means of intercollegiate arrangements. They think that among the recognised studies of the University there are some (such as natural science) for which the colleges cannot be expected to make adequate provision, either without, or by means of, those intercollegiate arrangements.

Many of the existing professorships are inadequately endowed, and ought to have their emoluments increased. Of a few the emoluments are in excess of what we think necessary. There are others the constitution, designation, and duties of which may, when they become vacant, be advantageously modified. The Commissioners also think that some new chairs should be established and adequately endowed.

The stipends of the professors (other than those of the theological faculty) should, in the Commissioners' opinion, be of varying amounts, according to the relation of their several

subjects to the studies of the University and to other circumstances material to be considered. Those of the following, among other Chairs should, they think, be augmented, so that the lowest of them should be not less than 700*l.* nor the highest more than 900*l.* per annum—namely, Astronomy; Geometry; Natural Philosophy; Chemistry.

They would also assign stipends, varying between the same limits, to the following Chairs, constituted by division or modification of existing foundations:—Physics—dividing between these two Chairs the subjects of the present Chair of Experimental Philosophy; Physiology; Human and Comparative Anatomy—dividing between those two Chairs the subjects of the present Linacre Professorship.

Stipends varying between the same limits should also be assigned to the following new Chairs, which they think ought to be established—English Language and Literature; Pure Mathematics; Mechanics and Engineering.

The stipends of the following Chairs should, they think, be augmented, so that the lowest of them should not be less than 400*l.*, nor the highest more than 500*l.* per annum—Medicine; Botany; Zoology; Geology; Mineralogy.

The evidence and opinions which the Commissioners have received lead them to the conclusion that it is expedient to develop as much as possible those branches of scientific instruction which are introductory and preliminary to medicine, rather than to attempt the establishment of a practical School of Medicine in Oxford.

It may be desirable to provide a reader in Human Anatomy, as assistant to the Professor of Human and Comparative Anatomy, with a stipend of from 250*l.* to 300*l.* per annum; and they think there should also be a reader (with a present stipend of 400*l.* per annum) in Invertebrate Anatomy, whose office, upon a vacancy in the Professorship of Zoology, should be united to that Chair, with such an increase in the emoluments of the professor as may make them equal to those of the Chair of Human and Comparative Anatomy, conditionally on his undertaking the additional duty.

Additional demonstrators appear to be required in several departments of natural science, who, in most cases may best be paid by fees, with supplementary grants when needful from the University chest.

There are several other purposes relative to the University which they regard as important, and for some of which definite provision ought to be made under the Act. Among these are:—

The foundation and endowment of scholarships or exhibitions tenable after a certain fixed period of residence in the University, for students in any special branches of study (including subjects which do not fall within the ordinary University course, such, for example, as medicine), which may be usefully promoted by such encouragement, under conditions properly adapted to make their enjoyment dependent upon the *bonâ fide* prosecution of such studies.

The encouragement of research, by the employment of properly qualified persons, under the direction of some University authority, in doing some definite work, or conducting some prescribed course of investigation, in any branch of literature or science; or by offering prizes or rewards for any such work or investigation.

The appointment and remuneration, from time to time, by the University authorities, of extraordinary professors or occasional lecturers in any subjects, either represented or not on the ordinary teaching staff of the University.

The last, and not the least important, of the main purposes relative to the University for which, in the Commissioners' opinion, provision should be made under the Act, is the creation of a common University fund, to be administered under the supervision of the University, in addition to its general corporate revenues.

They look to the creation of this fund (of which the formation must be gradual) as the proper resource for the supply of all the wants enumerated under the preceding head, except such of them as any college may propose to aid in supplying.

As to the sources from which funds for the above purposes should be obtained, they are of opinion that these funds must necessarily be obtained from the colleges.

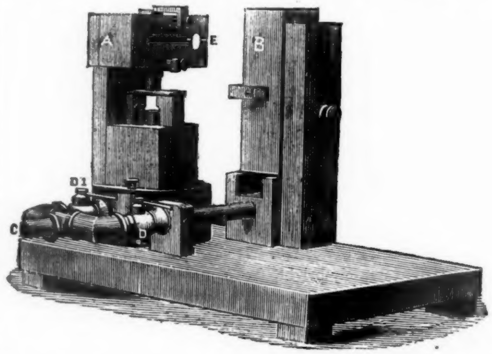
As to the principles on which payments by the colleges for the above-mentioned purposes should be contributed, it will be necessary to take into account the revenues, actual and prospective, of each college, and its actual and prospective wants for educational and other purposes, before they can form a judgment as to the amount which it should be called upon to contribute. They think it expedient to retain in Oxford a considerable number of prize fellowships (that is, fellowships not coupled with any specific duty or service to a college or to the University), for the encouragement and reward of meritorious students. Such fellowships should, they think, as a rule, be terminable; and their present impression is that their emoluments should be of uniform amount and should not exceed 200*l.* per annum.

The Commissioners have already received from some of the colleges proposals made, in a liberal spirit, in harmony with the views which they have expressed; and they are confident that they will receive such assistance from the University and the colleges generally, as may be necessary to enable them to determine when, and in what order of priority, provision shall be made for all the purposes specified in the first part of this statement.

AN IMPROVED METHOD OF PROJECTING LISSAJOUS' FIGURES ON THE SCREEN[1]

AS is well known, the vibrations of tuning-forks when used for the production of Lissajous' figures, are kept up either by the constant application of the violin bow, or by the aid of an electro-magnet; the former method requiring the presence of two assistants, and the latter adding materially to the complexity of the apparatus, and not unfrequently failing to produce the desired result. The difficulty is overcome in the present apparatus by the substitution of harmonium reeds for the tuning forks, the entire instrument being easily controlled by one operator.

The apparatus consists of a base board on which are planted the two reed boxes A and B. The box A is placed horizontally in such a manner as to be capable of slight rotation in the horizontal plane, and also of adjustment in height, by means of the support to which it is attached being provided with a slot and set screw. The box B is permanently attached to the base board in the vertical position. The boxes are so placed that a pencil of light falling directly on E would be reflected to B about one inch from its top; they are furnished with clamping screws



for the attachment of the reeds. The boxes are entirely open on the sides facing each other, their margins being covered with soft leather on which the reed plates bed, making a sufficiently air-tight joint. Wind is supplied through the brass tube C which gives off a branch to each box, a stopcock DD′ being inserted in each branch. The reeds are similar to those used in the construction of harmoniums; they are mounted on brass plates which fit the reed boxes. The tongue of each reed is furnished, at its free end, with a small reflector of microscopic covering-glass (E) silvered by Liebig's process, a piece of cork or pith being interposed between the tongue and the reflector, so as to free the latter from the frame of the reed; the reeds are then tuned in the usual manner. It is not necessary that the reeds should be in absolute tune, as, within certain limits, their relative vibrations can be adjusted by means of the stop-cocks, an advantage of great value, believed to be solely possessed by this apparatus.

The reed in the vertical box gives the fundamental ratio of vibrations from which the intervals are built up. Two fundamental reeds are used interchangeably, one giving the double or

[1] Paper read at Lit. and Phil. Soc., Manchester, February 5, by J. Dixon Mann, L.K.Q.C.P.]

eight feet C of musicians, the other, being an octave lower in pitch, adds an octave to the intervals obtained from the first fundamental; thus, the third with the first fundamental becomes the tenth with the sub-fundamental. The horizontal box is furnished with a set of reeds giving all the intervals up to the twelfth, including the unison. The horizontal reeds are changed for the production of the different figures, the fundamental reed being retained.

A free space of half an inch was allowed between the supply pipe and the reed box, so as to afford a cushion of air capable of yielding to the elasticity of the tongue. The supply pipe is contracted at its termination to about one-third the size of the hole in the reed box through which the wind enters.

The apparatus is used as follows:—The base board being firmly clamped to a rigid table, one of the fundamental reeds is clamped in front of the box B; another reed, giving the desired interval, is similarly clamped to the box B; an elastic tube, about half an inch in diameter, is attached at one end to the pipe C, and at the other to an acoustic bellows. A fine pencil of light is now thrown on the mirror E, which is then adjusted by rotation of the box A until the light strikes the mirror of the vertical reed, from whence it is reflected on to a screen of tracing paper placed a short distance away; a condenser, interposed between the lantern and the mirror E, focuses the spot of light on the screen. On the bellows being put in motion the figure appears, and can be brought to a perfect stand in any phase of development, looped or cusped, by careful manipulation of one or other of the cocks. The entire apparatus should be as rigid as possible, and free from any vibration other than that produced by the tongues of the reeds, and also that the wind supply should be perfectly steady.

THE PARIS OBSERVATORY

As we announced some time ago, an important step has been taken for the reorganisation of the Paris Observatory. A decree of the President of the French Republic has appointed ten members of the new council of the Observatory, in pursuance of the provisions of the organic decree we referred to two months ago. The principal object of this new institution being to connect the observatory with the several large French administrations, three Government departments have sent two delegates each. The War Office is represented by Col. Laussedat, the director of the balloon service, and Commander Perrier, the chief of the Ordnance Survey; the Minister of Marine by two rear-admirals, one of them, M. Jurier de la Gravière, being a member of the late Council; the other is M. Clouet; the department of agriculture by M. Tisserand, Director of the National School of Agriculture, and M. Hervé Mangon, a member of the Institute and president of the Meteorological Society of France. The Academy of Sciences is represented by four members, carefully selected, viz., M. Dumas, the perpetual secretary, who is to be appointed president, and M. Liouville, the celebrated geometer, and two astronomers, M. Faye and M. Mouchez, both of them members of the Section of Astronomy. It must be noted that the Council of the Observatory, although vested with the right to present to the minister two candidates for the directorship of that establishment, are not to interfere with the solution of technical questions. A special council composed of all the astronomers *en titre* of the Observatory, are to meet once a month to solve them with the director of the Observatory. The first meeting of the Council of the Observatory took place on April 24, M. Dumas being in the chair. The members had been summoned in order to send to the Ministry a list of two candidates for the direction rendered vacant by the demise of M. Leverrier. The meeting was very short, and the members having been unable to agree, it was postponed to the 26th, when M. Faye wished to deliberate on the vexed question of the separation of meteorology and astronomy. This, however, was not allowed, when M. Faye protested and declared that he would bring the question before the Academy of Sciences at its next meeting, on April 29. After several scrutinies the Council decided to send in the names of MM. Mouchez, Loewy, and Tisserand as their nominees for the directorship of the Observatory, the last two having obtained an equal number of votes. Such was the result of the deliberations of the Observatory Council, which on the whole seem to have been conducted with becoming dignity. At Monday's sitting of the Academy, M. Dumas simply read M. Bardoux's letter, and summoned a meeting for to-day of a Committee of the Academy composed of all the sections in the mathematical sciences. A list of candidates will then be formed for proposal to the whole Academy, which will vote its candidates on May 5. It then remains with the Government to choose between the candidates proposed by the Council and Academy. M. Faye made no protest at the Academy meeting on Monday, though, our correspondent writes, he was expected to speak on the subject in a secret committee which met after the meeting of the Academy. We trust that throughout these important steps for the appointment of a successor to Leverrier all personal feelings will be suppressed, and the interests of the Observatory and of science alone considered.

SOCIETIES AND ACADEMIES

London

Royal Society, February 7.—"On the Diurnal Range of the Magnetic Declination as recorded at the Trevandrum Observatory," by Balfour Stewart, LL.D., F.R.S., Professor of Natural Philosophy at Owens College, Manchester.

The Observatory at Trevandrum was supported by His Highness the Rajah of Travancore, and its director was Mr. J. A. Broun, F.R.S., who has recently published the first volume of the results of his labours, giving the individual observations of magnetic declination, and deducing from them conclusions of great scientific value.

Amongst the other results published by Mr. Broun, are the diurnal ranges of the magnetic declination at Trevandrum for each civil day in the eleven years, 1854 to 1864.

In one respect the treatment of the declination observations at Trevandrum differs from that pursued at the Kew Observatory, inasmuch as in the former place, where disturbances are little felt, the diurnal ranges are from all the observations.

Variations of Long Period.

In order to investigate the long-period variation of the Trevandrum declination-range, I have treated these observations precisely in the way in which the Kew declination-ranges were treated (*Proc. Roy. Soc.*, March 22, 1877). By this method proportional values of the declination-range at Trevandrum have been obtained corresponding to weekly points for each year, and it is believed that these values are freed from any recognised inequality depending either on the month of the year or on the relative position of the sun and moon. If this method should be found to furnish nearly the same results in the case of two observatories so widely apart as Kew and Trevandrum, and with such marked differences in the annual variation of the declination-range, we may conclude that this separation of inequalities has been successfully accomplished.

The proportional numbers have next been dealt with precisely in the way in which the corresponding numbers were dealt with in the case of the Kew Observatory, that is to say, a set of nine-monthly values of declination-range have been obtained corresponding to similar nine-monthly values of spotted solar area.

The results of this treatment are exhibited in the diagram which accompanies this paper.

In Fig. 1 we have a curve representing the nine-monthly values of spotted area.

In Fig. 2 we have the Kew and in Fig. 3 the Trevandrum declination curve represented by nine-monthly values of the proportional numbers.

In Fig. 4 we have a curve representing the mean between the proportional numbers of Kew and those of Trevandrum.

From these figures it will be seen that a lagging behind the sun is a feature both of the Kew and the Trevandrum curves, while generally the prominent points in the Kew and Trevandrum curves agree well together in point of time.

On the whole it would appear that by taking the mean of the proportional numbers for the two stations, we get a curve that represents the solar curve better than one derived from a single station.

The whole period compared together represents both for the solar curve (Fig. 1) and the mean curve (Fig. 4), a series of three smaller periods, one extending from B to C and embracing the maximum; another extending from C to *c*, and a third from *c* to *e*; and this is as far as the observations common to both stations allow us to go in point of time.

It may be of interest to compare, by means of the tables, the period between the solar minimum of 1855 and that of 1867, with the period between the corresponding declination-range minima. The first of these declination minima occurred at Trevandrum (the

Kew observations not having then begun) on February 15, 1856, and the second of them occurred at Kew (the Trevandrum observations having been discontinued) on August 15, 1867. The period is thus one of eleven years and six months.

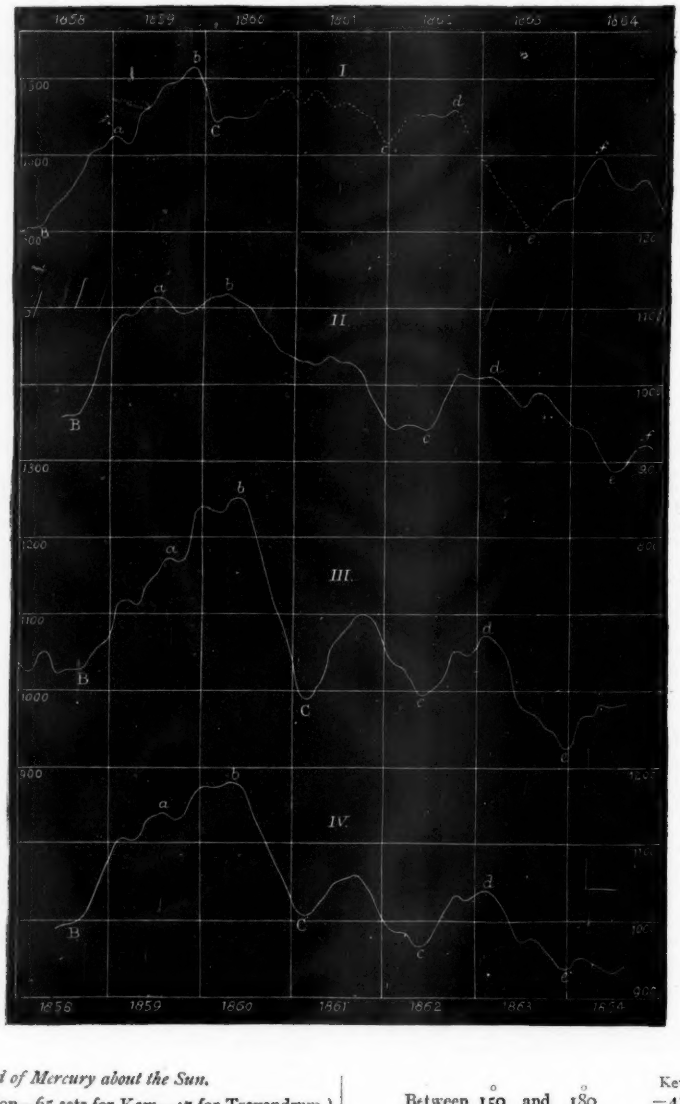
On the other hand, the sun-spot period is that between September 15, 1855, and March 15, 1867, being likewise eleven years and six months.

d. Variations which seem to depend on Planetary Configurations.

In a paper on the Kew declination-range already alluded to, it was shown that the planetary periods of most frequent occurrence appear to be well indicated by the results of sixteen years' observations. Indeed, for the two periods of shortest length—that of Mercury about the sun, and that of Mercury and Jupiter, it was found that half of the observations gave a result of the same character as the whole sixteen years.

From this we might conclude that these periods will probably (if they have a real existence) be indicated by the Trevandrum observations.

It will be seen from the following tables that the Trevandrum declination-ranges give results for these two planetary periods very similar to those given by the Kew observations.



Period of Mercury about the Sun.

(0° denoting Perihelion—65 sets for Kew—47 for Trevandrum.)

	Kew.	Trevandrum.
Between 0° and 30°	+429	+263
,, 30 ,, 60	+433	+223
,, 60 ,, 90	+256	+237
,, 90 ,, 120	+ 5	+300
,, 120 ,, 150	−280	+150
Between 150° and 180°	−439	−433
,, 180 ,, 210	−413	−879
,, 210 ,, 240	−279	−740
,, 240 ,, 270	−140	−263
,, 270 ,, 300	+ 13	+333
,, 300 ,, 330	+158	+680
,, 330 ,, 360	+278	+506

Period of Conjunction of Mercury and Jupiter.

(0° denoting Conjunction—63 sets for Kew—43 sets for Trevandrum.)

	°		°	Kew.	Trevandrum.
Between	0	and	30	+633	+453
"	30	"	60	+759	+270
"	60	"	90	+652	+129
"	90	"	120	+328	−118
"	120	"	150	−119	−384
"	150	"	180	−504	−467
"	180	"	210	−678	−487
"	210	"	240	−677	−407
"	240	"	270	−548	−122
"	270	"	300	−322	+223
"	300	"	330	− 10	+415
"	330	"	360	+343	+503

Zoological Society, April 16.—E. W. H. Holdsworth, F.Z.S., in the chair.—Mr. Sclater exhibited and made remarks on a typical specimen of the new fox lately described by Mr. Blanford as *Vulpes canus*, from Baluchistan.—The Secretary exhibited, on behalf of Mr. A. Anderson, F.Z.S., a bamboo stick with leather thong attached to it, such as is used in India for driving plough-cattle with, which had been taken out of a nest of the common Fish Eagle (*Haliaetus leucoryphus*), in December, 1876.—Prof. Westwood communicated a memoir on the Uraniidæ, a family of lepidopterous insects, with a synopsis of the family and a monograph of one of the genera, *Coronidia*. These insects were remarkable for their extreme beauty and the difficulty which had attended their systematic classification. Their relations with other groups of lepidopterous insects were discussed at considerable length, and their nearest affinities were shown to be with certain other moths belonging to the great division of the Bombyces, whilst their connection with the Hesperian butterflies, the Pseudo-sphinges, Erebideous Noctæ and Ourapterygeous Geometre was disproved by their general structure, the venation of their wings and their transformations. A synopsis of the species of all the genera was given, and a complete monograph with figures of the genus *Coronidia*.—Mr. Gwyn Jeffreys, F.R.S., F.Z.S., read the first part of his work on the Mollusca, procured in the expeditions of H.M. S.S. *Lightning* and *Porcupine*. It would be recollected that these expeditions immediately preceded that of H.M.S. *Challenger*, but were restricted to portions of the North Atlantic, including the Mediterranean. The Brachiopods formed the subject of the present paper. A table of all the Brachiopods known to inhabit the European seas was given, comprising ten genera and twenty-two species, of which latter four were for the first time described and six figured. The table also particularised the geological and bathymetrical range of all the species. Two plates accompanied the paper, and were furnished by Mr. Davidson.—Mr. G. E. Loder, F.Z.S., exhibited and made remarks on a mounted head of the Rocky Mountain Bison, remarkable for its soft, dark, and long hair on the forehead. This specimen had been obtained near Denver, Colorado.—A communication was read from the Marquis of Tweeddale, F.R.S., containing the eighth of his contributions to the ornithology of the Philippines. The present paper gave an account of some Luzon birds in the Museum at Darmstadt, which had been sent to him for examination by Prof. Koch of that place.—A communication was read from Dr. O. Finsch, C.M.Z.S., containing description of a new species of finch from the Feejee Islands, which he proposed to name *Amblynura kleinschmidti* after Mr. Kleinschmidt, by whom it had been found in the interior of Viti-Levu.—Dr. M. Watson read a paper containing a description of the generative organs of the male spotted hyæna (*Hyæna crocuta*), and a detailed comparison of them with those of the female of the same animal.—Messrs. Sclater and Salvin read a report on the collection of birds made during the voyage of H.M.S. *Challenger* at the Island of Juan Fernandez, at various points along the coast of Patagonia, and at the Falkland Islands.—A second paper by Messrs. Sclater and Salvin gave descriptions of three new species of birds from Ecuador, proposed to be called *Buarremon leucopis*, *Neomorphus radiolosus*, and *Aramides calopterus*.

WELLINGTON, N.Z.

Philosophical Society, August 18, 1877.—After the confirmation of the previous meeting's minutes, and the announcement of Mr. B. T. Chaytor and Mr. Robert Govett as newly elected members, the President (Mr. W. T. L. Travers, F.L.S., M.H.R.), read his paper on remarks as to the cause of the warmer climate which existed in high northern latitudes during former geological periods. This paper was a review of the progress recently made in our knowledge of the subject, and especially the bearing of Naysmith and Carpenter's examination of the moon's surface, and the work by Mr. Mathieu Williams on the "Fuel of the Sun." The author adopted the view that the gradual condensation of water on the earth's surface, consequent on the loss of its original cosmical heat, had produced the succession of phenomena resulting in the present distribution of life; that in consequence of the cooling having taken place first in the polar regions, it was there that the higher and latest-formed organisms must have first appeared. He adduced as proof of this the existence of fossilised vegetation within the Arctic regions which had almost a tropical character, and other evidence that during successive geological epochs the changing character of the fauna and flora in other regions showed that the climate had gradually become more and more temperate. Dr. Hector would only speak as regards the geological aspect of the author's paper. The fact that the oldest rocks we know are either hydrated or formed by the action of water as sediments proved that our geological records did not carry us back to a time when very high temperature prevailed. It was only, therefore, necessary to inquire into the evidence of a minute secular cooling afforded by the succession and distribution of animals and plants during former epochs. He considered this evidence very unsatisfactory, and not leading in the direction the author required. The former existence of temperate plants in high latitudes took place at a very late period in the earth's history, and long after some temperate regions had possessed a fauna and flora similar to that at the present time. There had, in fact, been several repetitions of the abnormal distribution of animals and plants on which the author founded his argument, and consequently of the climate; so that these changes could hardly be referred to the progressive cooling of the globe as a whole. The inferences made had chiefly been drawn from late tertiary strata, but in the case of New Zealand there was evidence that the same type of vegetation had survived since the early part of the cretaceous era, a period twenty times as great as that which had elapsed since the supposed sub-tropical fauna inhabited Central Europe, or the temperate flora flourished in the Arctic regions. From this it was surely to be argued that the cause had not been one of universal operation. Concerning the former Arctic flora the real difficulty was not the question of temperature so much as the absence of light in that region for six months of the year if all other conditions of the earth remained as at present, except a general higher surface temperature. Many speculations had been put forward on this subject; one of the latest, by John Evans, was that the earth was solid with an oxydised crust, separated from the central nucleus by a viscous layer of unequal thickness in which chemical combination, or, as it may be called, the "rusting process," was still active. The elevation of mountain masses by the fracture of the crust would act like weights on a gyroscope and lead to a gradual displacement of the outer crust with reference to the axis of rotation of the interior bulk of the earth, which astronomers required us to believe to be immovable. He also pointed to recent researches of Prof. Duncan regarding reef-building corals, which at the present time are confined to a narrow equatorial belt, but in eocene times that belt appears to have had a distribution oblique to the present equator. If this were established it would offer a still greater difficulty in the way of accepting the view that the changes in distribution of climate were due to the secular cooling of the earth as a prime cause. Mr. Carruthers thought it not yet proved that there was a central heat, and certainly not that it could influence climate. He thought the balance of evidence was against the theory of central heat. If the earth had once been hotter it would have become smaller in cooling, and its velocity of rotation would have increased; but this was contrary to fact, as the rotation had been retarded by about three hours since exact observations were first made. With regard to what had been said about the thickness of the earth's crust, the existence of tides proved that it must be so great as to be absolutely rigid. He considered it quite possible for plants to live in darkness if they remained dormant, like geraniums, which are placed in a dark cellar during the winter.

September 1, 1877.—Mr. W. T. L. Travers, president, in the chair.—Mr. Coleman Phillips read his paper on a peculiar method of arrow propulsion as observed by the Maoris. The author gave an interesting description of how

the arrows were thrown by means of a string, which he illustrated before the meeting with a model. He expressed surprise that, as far as he was aware, nothing was known of the bow among the Maoris, a weapon so commonly used by natives of other islands. Mr. Grace, who had been in New Zealand from his youth, said that the bow and arrow was a common weapon in the interior with the Maori youths, and he believed that it was originally used by the natives. It was, however, found by them to be an inconvenient weapon in the bush, and hence their reason for adopting the plan mentioned by Mr. Phillips. The Maori scarcely ever threw a spear by hand; they used the string twisted round a fork in the spear. The notch mentioned by the author was new to him.—The President read a paper on grasses and fodder plants by Dr. Curl, being a continuation of a paper by the same author read last year, and printed in vol. ix. of the *Transactions*.—Mr. Carruthers read a paper on a system of weights and measures, in which it was proposed to change the radix of counting from 10 to 16, and to adopt the latter number as the radix for all weights and measures.

PHILADELPHIA

Academy of Natural Sciences, November 13.—The agricultural ants of Texas, by Rev. H. C. McCook.—On a stone axe, by Mr. J. Ford. This was found in a bluff fifty feet above the level of the Mississippi, and embedded twenty feet deep in solid limestone, without fissure or crevice, giving evidence of great age.

November 27.—Remarks on American species of *Difflugia*, by Prof. Leidy.—On the aëronautic flight of spiders, by Rev. H. C. McCook.

VIENNA

Imperial Academy of Sciences, February 7.—"Monographia Pulmonariarum," by M. Kerner.—On bixin, by M. Etti.—A centrifugal air-ship, by MM. Szigyarto and Kuczera.—On the originals of v. Born's Testaceis Musei Cæsarei Vindobonensis (1780), found in the Imperial Zoological Museum, by M. Brauer.—On new neuroptera, by M. Steindachner.—On a peculiar spinal cord band in some reptilia and amphibia, by M. Berger.

February 14.—Construction of tangents at the contact line of a rotation surface and the developables described outwards and round it from a point, by M. Drasch.—Completing additions to the general mode of determination of the focus of contours of surfaces of the second degree, by M. Pelz.—On the action of bromine on phenoldisulphoacid, by M. Schmidt.—On the products of decomposition of a gum-ammoniac of Morocco by melting hydrate of potash, by Dr. Goldschmidt.—Telephone signalling apparatus, by M. Puluj.

ROME

R. Accademia dei Lincei, February 3.—New researches on the ossiferous caves of Liguria, by MM. Gasteldi and Ferroti.—Discovery of arms of stone and bronze in Calabria, by M. Ruggeri.—Geological and palæontological studies on the middle cretaceus of Southern Italy, by M. Seguenza.—On benzylic santonate, and on tribenzylamine and its chloroplatinate, chlorhydrate, sulphate, alum, and nitrate, by M. Panebianco.—On the new anomalous anastomosis between the trochlean nerve, the supra-orbital and the sympathica cavernosa, by M. Berté.—New general theorem of mechanics, by M. Cerruti.

PARIS

Academy of Sciences, April 22.—M. Fizeau in the chair.—The following among other papers were read:—Researches relative to the action of dry oxalic acid on primary, secondary, and tertiary alcohols, by MM. Cahours and Demarçay. This is in completion of a former study (C. R. vol. lxxxiii. p. 688). The experiments were made with methylic alcohol, primary and secondary octylic alcohol, trimethyl-carbinol, and dimethyl ethyl-carbinol. The action of dry oxalic acid on tertiary alcohols, which consists in splitting them into hydrocarbons and water which unites with the acid, establishes a very marked distinction between them and primary and secondary alcohols, which, in like circumstances, are transformed always into oxalates.—Report on a memoir by Lieut. Pinheiro of the Brazilian navy, on a sondograph. This instrument is for giving information regarding banks in rivers. A wooden rod is fitted at its lower end with a hollow roller to roll on the bottom and collect small portions of the material; at the top it is articulated round a horizontal axis carrying a graduated arc (which shows the various inclinations) and also a toothed wheel, which, though a pinion and eccentric, gives a straight motion to a style, tracing a continuous curve on a moving band of paper.—M. Gaiffe exhibited a manometric safety steelyard. It is mounted on steel pivots, and connected with a piston having ten square millimetres of surface. It indicates with precision the pressure of the boiler. Annexed is an alarm whistle communicating with a valve box by a graduated rod.—A letter from M. André was read, announcing the arrival at Ogden, Utah, of the party sent out to observe the transit of Mercury. The U.S. Government had given them the use of the nearly finished observatory at Ogden, and any instruments they wished; the photographic instruments used by the American Venus transit expedition were put in their hands. A telegraph wire connects Ogden with Washington.—Observations of solar spots and protuberances during the first quarter of 1878, by M. Tacchini. The number of spots has continuously diminished since the beginning of last year, so that the minimum appears to fall, not in 1877, but in 1878. The protuberances, too, have been very few and small: 2·1 on an average daily, with a height of half a minute; they occupy only 3·5° of the solar limb. In distribution they extend over a large zone, but with the peculiarity of two characteristic maxima beyond the principal zones of spots, *i.e.* between 30° and 60° in both hemispheres. The nebulous structure predominated. There were no isolated metallic eruptions.—On observations of Mercury, made at the end of last century, by Vidal at Mirepoix, by M. Bigourdan. These are shown to be as accurate as was possible with the means at Vidal's disposal.—Results of experiments made at various points of Algeria, in industrial use of solar heat, by M. Mouchot. The reflectors he finds best are made of a plate of silver, or brass electro-plated with a thin layer of silver. At Algiers the heat received per minute by his solar boiler was 7 calories in April, 8 in May, and 8·5 in June and July. M. Mouchot tabulates the results obtained in various localities; they range from 9·8 cal. to 5.—On a large fossil reptile (*Eurysaurus raincourti*), by M. Gaudry. The remains of this were come upon by workmen in a quarry near Vesoul, as far back as 1861. A Dr. Gevrey happened to pass and brought some of the blocks of bone to Vesoul, where they have been forgotten seventeen years. The Marquis de Raincourt having seen them perceived their interesting nature. The remains are estimated to have covered a space five metres in length. The animal has affinities to the plesiosaurians, but it is not a true plesiosaurus, for its head is so heavy and its teeth are so large that it could not have had a very long neck. The cervical vertebræ, too, are narrower and convex behind. The cranium was flattened and the teeth were directed outwards. The nostrils must have been placed far back.

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